Participatory design adapted for elderly collaborators: design of a platform to support elderly museum volunteers

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Abstract

The thesis purpose is to gather recommendations to adapt participatory design to elderly users, through the involvement of an association of elderly museum volunteers. The outcome is the result of a participatory process that included forms, interviews, cultural probes, and workshops where the volunteers and designer collaborated tightly to explore volunteers' needs and find solutions to address them. This process led to the design of a platform that empowers volunteers' work and recognizes its value. The platform includes sections managed by the volunteers to archive information about the museum pieces, share organized activities, and receive feedback from visitors to improve their work.

Content

1 Introduction

This thesis foundation is the participatory design (PD) methodology and how its activities can be adapted for elderly collaborators. To extract insights about this matter, a collaboration with an association of elderly museum volunteers is carried out to design a platform to support their work. For this reason, knowledge is also being gathered about interfaces and platforms that are suitable for the elderly.

Firstly, a definition of the elderly is needed. There have been different criteria to define what the term elderly refers to; it depends on the geographical context (conditions in developed vs. underdeveloped countries), physical degeneration, and even social, cultural, economic, and political context. However, to frame this term related to age, it is taken the UN definition: elderly are citizens 60+ years old (Elguera Paez & Zapata Del Río, 2019; Shih-Hsun & Wen Huei, 2013).

1.1 GDPR

According to European law, legal persons don't have GDPR, and therefore this project reveals the association's name with which it was developed. In addition, all the information collected during the design phase was the opinions and experiences of the volunteers, not personal information that could be directly or indirectly related to them as individuals. These two assertions are based on the following statements: "Personal data is any information that can be directly or indirectly attributed to a living person" (*Writing Your Degree Project | Student Web*, n.d.-b), "[…] data protection does not apply to information about legal entities such as corporations, foundations and institutions" ('Personal Data', n.d.-a) and "This Regulation does not cover the processing of personal data which concerns legal persons and in particular undertakings established as legal persons, including the name and the form of the legal person and the contact details of the legal person" (Radley-Gardner et al., 2016).

1.2 Case

This thesis is based on the collaboration with a group of elderly museum volunteers that belong to an association from the south of Spain called 'Asociación de Voluntarios Culturales del Museo de la Alhambra' (Jiménez, 2019). They are all 60+ and their work consists of offering free guided tours to the public that visit the museum; tours based on knowledge and experience.

The power structure of this association is complex; its work depends on two other actors. There is a top association called CEATE (*CEATE – Confederación Española de Aulas de Tercera Edad*, n.d.), which promotes an active life for aged citizens through their involvement in diverse activities, such as museum guiding programs. The association this thesis is collaborating with belongs to it. As well, there is the museum institution, the entity which administers the use of the museum spaces where the volunteers offer their guiding program. An organization diagram is shown in Figure 1.
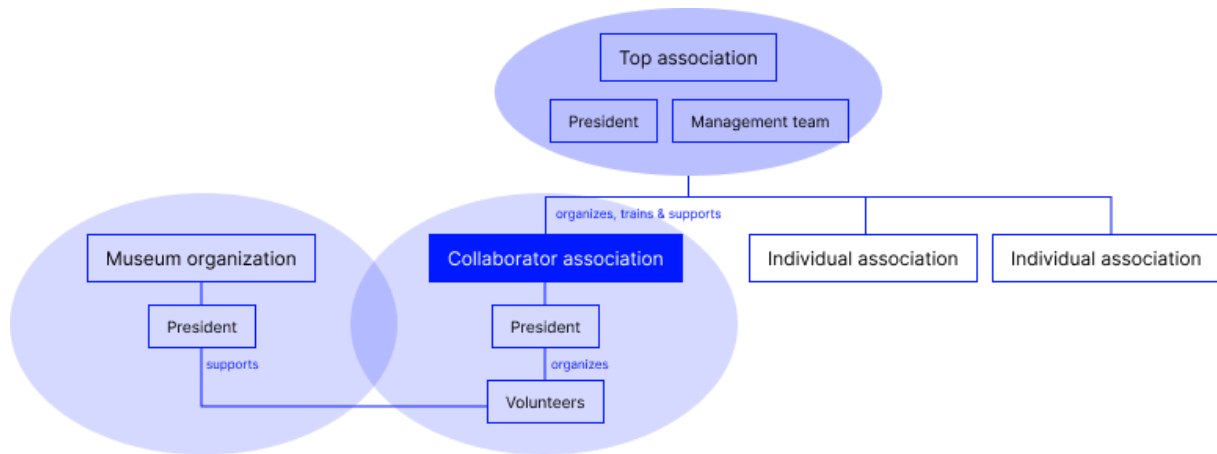
Figure 1. Organization diagram

1.3 Aims

1. Contribution of knowledge to the practice of participatory design and user interface design for the elderly.

The elderly are a growing population requiring specialised technology solutions. However, the technology industry hasn't considered their needs in the design process (Elguera Paez & Zapata Del Río, 2019). It is noted that participatory design can be a solution for designing products for the elderly, as it takes into account their specific context. However, it's needed to provide insights on how to adapt activities to this user group and engage them. User interface design also influences engagement and adoption of platforms by the elderly and should therefore be explored.

2. Development of a platform for the volunteers in the case.

Use the knowledge of participatory design and user interface design tailored to the elderly, as well as the theory of platform studies, to design a platform to support the work of museum volunteers. In addition, use the state of the art section, which includes platforms designed for the elderly, to inform the design.

1.4 Research questions and expected knowledge contribution

1. How might participatory design be adapted for elderly collaborators?
2. How might user interfaces be adapted for elderly users?
3. How might platforms be adapted for elderly users?

The expected knowledge contribution would be advice on how to adapt a participatory design methodology and its activities to elderly collaboration, as Righi et al. (2017) and Duque et al. (2019) pointed out its need. It's also expected to bring guidance to designers on how participatory design can improve the acceptance and use of technologies, as well as the digital literacy of elderly users, minimizing the effects of the digital exclusion they suffer. This was problematized by Dupuy et al. (2016). In addition, knowledge of elderly-friendly user interface design and platform design is expected.

2 Theoretical background

This section is divided into two parts:

Part 1 justifies the importance of including the elderly in the design of technology. It looks at including them as collaborators in a participatory design methodology and adapting user interfaces to their limitations.

Part 2 belongs to the subfield of IxD platform studies. Here the definition of platform is revised and reformulated to fit the characteristics of this project, and the state of the art of platforms tailored to the elderly is presented.

2.1 Part 1: Importance of designing for elderly

The elderly are a population group in expansion. In 2017 it was counted that 13% of the population in the world belonged to this group; in 2050 is expected that a quarter of the global population will be 60+ in all the continents except Africa, making it the fastest-growing age group (Elguera Paez & Zapata Del Río, 2019; Sorgalla et al., 2017). Therefore, they constitute a dense population to design technology for (Duque et al., 2019).

The elderly are less inclined to use technology because they don't find designs adapted to their needs (Elguera Paez & Zapata Del Río, 2019), as current development strategies don't take them into account. The elderly are neither included as collaborators in the process, which leads to design flaws that could otherwise be prevented (Duque et al., 2019). User interface design faces the same problematic situation when addressing the needs of elderly users (Elguera Paez & Zapata Del Río, 2019).

Marketed digital products for the elderly are only a few and they usually have only some features adapted for them. This leads to a limitation in the technology-supported activities for the elderly (Elguera Paez & Zapata Del Río, 2019; Sanders & Stappers, 2013), as well as the marginalization of digital information (Chou et al., 2013).

2.1.1 Participatory design as a tool to design elderly-friendly technology

The technology industry is currently focused on young people, excluding the elderly from digital product development. However, the rapid growth of their population has brought the need for an inclusive approach (Duque et al., 2019). Previous research has shown the importance of the elderly as co-creators: this approach brings benefits such as an increase in acceptance, accessibility, efficiency, and satisfaction with digital products (de Podestá Gaspar et al., 2018; Demirbilek & Demirkan, 2004; Sorgalla et al., 2017), as well as decreases the fear of using the system (Demirbilek & Demirkan, 2004; Häikiö et al., 2007). As well, traditional design methods may not be sufficient to develop technology for such a demanding group (de Podestá Gaspar et al., 2018; Holzinger et al., 2011; Rébola & Jones, 2013; Sorgalla et al., 2017). Participatory design is a relevant methodology to design for a specific target audience: it takes into account the users' context and through the co-creation of technology, gives them a sense of ownership (Bødker et al., 2022). Therefore, it is a valid

method for elderly design. More information about this method can be consulted in the section Participatory design.

There are previous examples where this method provided technologies that the elderly felt proud of and engaged with (Hakobyan et al., 2016). It has been used to develop diverse systems for the elderly, ranging from healthcare, assistive technologies, robotic pets, or information management systems for community centers (Davidson & Jensen, 2013). However, it's needed to adapt the current methodology to elderly limitations, tailoring design activities to their possibilities, and finding ways to engage with them (Demirbilek & Demirkan, 2004; Duque et al., 2019). Several papers have been reviewed to adapt the participatory design process to elderly participants. Papers that followed a user-centered methodology, and explained the process behind it were selected. The review is shown in Appendix A. Recommendations to adapt design activities to the elderly: a review of papers with participatory approach.

These papers mentioned as well the challenge of setting a collaboration with elderly participants. It's recommended to find a community-based group, where their bond is not only their age but common interests or activities. The elderly are a heterogeneous group; although aging brings common limitations and needs, they still vary between individuals (de Podestá Gaspar et al., 2018; Duque et al., 2019; Righi et al., 2017). As well, working with elderly participants that are geographically separated involves technology-mediated communication, which represents a risk for the elderly (Duque et al., 2019).

2.1.2 User interface design for elderly

To improve users' technology experience, it's relevant to design a proper user interface that allows easy learning, comprehension, and manipulation of its components (Elguera Paez & Zapata Del Río, 2019). This project aims to introduce a participatory approach to interface design to facilitate meeting the needs of the elderly through their direct involvement. Elderly users find it challenging to adopt technologies where the interface design isn't adapted to their age-related limitations (Häikiö et al., 2007), providing too complex solutions (Chou et al., 2013). Several projects discuss the design of elderly-friendly interfaces. They study their limitations and offer recommendations to palliate their effects (Alsana et al., 2020; de Podestá Gaspar et al., 2018; Elguera Paez & Zapata Del Río, 2019; Häikiö et al., 2007; Kalimullah & Sushmitha, 2017). These recommendations are shown in Appendix B. Recommendations to design elderly-friendly interfaces: papers review.

Most elderly users have age-related limitations in their physiological, psychical, and cognitive skills (Chou et al., 2013; Elguera Paez & Zapata Del Río, 2019; Shih-Hsun & Wen Huei, 2013). However, the level of these limitations depends on individual cases (Duque et al., 2019). According to the physiological skills, the elderly usually have deficient hearing, vision (*e.g.* slower adaptation to light and focus changes), memory (especially prospective memory), judgment, hand-eye coordination, and muscle deterioration (*e.g.* difficulties in performing fine movements). As well, they take usually 50-100% more time to carry out actions than

users below 30. According to the psychical skills, the elderly usually lower their confidence because of their physical deterioration. As well, past experiences and attitudes have led them to feel computer anxiety. According to cognitive skills, the elderly usually have a short memory, lack of concentration, and of ability to manage complex tasks. These problems are related to their physiological deterioration.

2.2 Part 2: Platform studies

The definition of platform has changed over the years. Traditionally, platform studies have looked at how devices and software environments enabled other applications to be built on top of them (Plantin et al., 2018). This definition has been defended by others: "a platform is a system that can be programmed and therefore customized by outside developers— users—and in that way, adapted to countless needs and niches that the platform's original developers could not have possibly contemplated, much less had time to accommodate" (Andreessen, 2007). However, this traditional computational meaning, with a focus on programming, has been challenged and loosened by current digital industries.

Gillespie (2010) argues for the importance of platforms as intermediaries of digital content, where user-generated content (UGC), streaming media, blogging, etc. are made available. This is based on the synthesis of definitions of platforms from the computational, figurative, architectural and political meanings. However, this approach is being pushed by large corporations such as Google who want to market their products as neutral intermediaries of UGC to fit their desired legal framework and downplay their agency. These commercial platforms allow users to create content beyond the designer's ideas but with constraints that support the platform's revenue; they are designed to allow free expression, but to monitor this by analysing data (e.g. targeting personalised ads to individuals) (Gillespie, 2010; Plantin et al., 2018). This definition portrays platforms as a product tailored by large corporations, where the needs of users are not taken into account. However, this approach is at odds with the participatory principles of collaborative design. Participatory design would develop platforms according to a bottom-up strategy, ensuring democracy in the design process without the constraints of generating economic revenue.

To clarify the intention of this project, a definition of platform is proposed. A platform is a digital content intermediary that enables the sharing of UGC within a community. It takes into account the programmability concerns of the original definition, understanding that adding or modifying content is programming; it pursues the freedom of expression of commercial platforms; and it focuses on the empowering principles of participatory design, claiming democracy in the design process.

2.2.1 Engagement and adoption of platforms by the elderly

Platforms have brought benefits to society and the reliance on them is expected to increase in the future; however, not everyone is able to enjoy them. There's a digital divide, which is the term used to describe the exclusion of some population groups, such as the elderly, from

digital information services. Four different factors have been identified that influence the engagement and adoption of digital platforms by the elderly (Ghosh, 2019):

1. Perceived usefulness. The elderly engage with platforms as an everyday way of entertainment. The most common activities include checking email, researching topics of interest (health-related topics, news, weather, etc.) and staying in touch with distant relatives. The elderly with greater skills may also play games or shop online.

2. Perceived ease of use. The elderly's main concerns about the Internet are the misconception that it's difficult to use, as well as privacy and security. Studies show that the easier it is for the elderly to access platforms and the more time they spend on them, the more likely they are to engage.

3. Perceived risk. The elderly who are not familiar with platforms feel unsafe when using them. The lack of ability to physically manipulate a digital product and control their personal and financial information also implies risk for them. The necessary trust is built by using the platform and understanding how it works. However, previous experiences strongly determine the elderly usage.

4. Anxiety. The elderly didn't grow up with computers and are not familiar with them. Therefore, learning how to use platforms, coupled with the decline in their physical abilities which lowers their confidence, becomes a major challenge for them.

2.2.2 State of the art: Platforms designed for the elderly

Platforms have been developed for the elderly in different sectors, but in this section, projects related to access to services, active lifestyles and social media are presented. Although most platform related work sees the elderly as dependent users, this section wanted to construct a positive view with projects that empower the elderly to participate in the digital society through technology and design mediated help.

Access to services

Social networking sites (SNS) are platforms for creating and maintaining social circles to avoid social isolation. Recently, e-commerce platforms have also converged with SNS. For example, platforms such as eBay allow social interaction during the sale of products. The next step has been the emergence of collaborative consumption platforms, where users share products and services with their peers (e.g. AirBnb, car rental, etc.) Although SNS have a global scope, there's a trend to target local communities, such as neighbourhoods (Koene et al., 2012). Therefore, these platforms could allow the elderly to participate in the online community while fostering intergenerational communication with their neighbourhood.

To investigate the adoption of SNS by the elderly, a local service-oriented platform called BDe was created (Koene et al., 2012). The methodology followed a participatory approach with focus groups and pilot phases. The design requirements gathered were: intuitive interaction and navigation; geographically closed community to ensure privacy and security;

transparent privacy; community awareness; and request-based service trading. The final design of BDe allowed registered users to post service requests on the platform wall which could be responded with an offer, question or comment. Participants were notified of any changes of offer status until the requester accepted it. The owner of the offer then received more information about the service. The results showed that the elderly agreed on maintaining real-world social relationships through an online neighbourhood to prevent loneliness and enjoy independence. However, they still had concerns about the privacy of personal information and the security of the services.

Another project developed in this area is QuartiersNETZ (Sorgalla et al., 2017), a platform that provides services to the elderly in the neighbourhood (e.g. supermarket, pharmacy), supports social relationships with family and friends, and notifies of upcoming events. A customised version has been set up in four neighbourhoods, as well as technology clubs to familiarise citizens with the technology (Rüßler & Sachweh, 2014).

Active lifestyle

Platforms that mix physical activity with gaming (called 'exergaming') promote healthy lifestyles for the elderly (Awada et al., 2017; Konstantinidis et al., 2016). Although guidelines for designing them with interactions and exercise regimes tailored for the elderly have been proposed, they haven't been adopted by the market (Konstantinidis et al., 2016).

FitForAll is an exergaming platform created to study its acceptance among the elderly (Konstantinidis et al., 2016). It includes a combination of physical exercises tailored for the elderly and a gaming environment to encourage adherence to physical routines. It uses hardware such as Nintendo controllers and the Balance Board with custom software to take sensory information from the user's movements, translate it into game input and compare it to the physical exercises. The game updates according to this input, providing tailored feedback and adjusting intensity and difficulty according to the user's progress. The evaluation of the platform reflected the outstanding usability, which determined user engagement, as well as improvements in the physical condition of the elderly.

Old@Mobile is another exergaming platform (Awada et al., 2017). Its games involve two avatars, the elderly avatar and the trainer avatar. The user follows the movements of the trainer avatar, which are captured by a Kinect camera and mapped. The level of difficulty is adjusted based on the user's health, and the results and health constants are stored in a database. The design of the platform is tailored to the elderly. Its interface design is critical for system acceptance and must adapt to different interactions, user preferences and environment. Therefore, the design allows for gesture and voice input, and it takes into account their language, visual preferences, most used features and behaviour. The exergames present large fonts with explanatory videos and continuous instructions throughout the sessions to avoid memory overload.

Social media

The elderly in Western cultures experience increasing social isolation as their network declines with age. Therefore, social media for the elderly aims to strengthen relationships and find people with common interests (Bothorel et al., 2011).

The project of Bothorel et al. (2011) consisted of customising the Mazadoo platform to adapt Facebook content and functions to TV screens in care homes. Mazadoo allowed the elderly to interact with posts, have messages read to them, and record messages using their phones. A profile of the care home was created where activities, menus and photos or events could be accessed by the elderly and their families. The design process involved various stakeholders, especially the elderly, in interviews and an evaluation. The results showed that elders who had a strong network but didn't receive visits were more engaged with the system, while the rest of the elders demanded content tailored to their interests.

In the study of Shih-Hsun & Wen Huei (2013) a platform was created to promote social interactions among the elderly through a participatory approach. The user interface consisted on a television set equipped with a webcam and remote control, allowing for navigation, handwriting and voice interactions. The design provided access to social media and information platforms where they could send messages and connect with family and friends, as well as navigate through TV channels, radio stations and videos. The testing and final results showed that an intuitive interface helped the elderly to overcome their fear of technology. The system wasn't intended to replace face-to-face interaction, but to provide additional ways to stay in close contact with family and friends.

2.3 Intersection between platforms, participatory design and user interface design

The state of the art section presents the challenge of engagement and adoption of platforms by the elderly, as it depends on factors such as ease of use and usefulness. Therefore, a participatory approach to the design of these digital services can help to properly identify and meet the needs and desires of the elderly. The user interface is also recognised as a critical part of the platform design to improve adoption, and therefore a participatory approach to its design may result in a more tailored solution.

3 Methods

Participatory design

Participatory design is a method that brings designers, users, and stakeholders together in the design process through active participation (Martin & Hanington, 2012). Its foundations are mutual learning and empowerment of people, seeing them as skillful and resourceful. Collaboration to achieve shared goals and reflection on current practice and future alternatives leads to learning between individuals. This method collaborates with democracy

claiming that everyone can support future practices; it works towards emancipatory practices, being especially useful in situations of power inequality (Bødker et al., 2022).

This method started in the Scandinavian countries in the 1970s with projects where the negotiation of computer integration in workspaces was under debate. These projects intended to take into account the opinion of workers, through collaboration with multidisciplinary teams. Since its origin, it has expanded to several disciplines such as architecture, industrial design, and graphic design (Bødker et al., 2022; Martin & Hanington, 2012).

The goal of participatory design is not to develop a single method to design but rather to offer a systematic organization of the activities with a specific selection of procedures (de Podestá Gaspar et al., 2018). It focuses on actively engaging users and stakeholders in co-design activities through the deployment of a variety of methods, such as field studies and workshops, and phases such as infrastructuring and evaluation (Bødker et al., 2022). The participants' insights from these activities are paired with the designers' expertise to generate outcomes where participants' voices are represented (Martin & Hanington, 2012).

3.1 Discover

3.1.1 Literature review

According to Martin & Hanington (2012) "Literature reviews are an integral part of academic papers, but are also a useful component of any design project, to collect and synthesize research on a given topic" (p. 258).

Literature review, also known as secondary research, consists of extracting information related to the research topic from different published sources (books, academic journals, conferences, previous documented projects, etc.) (Sanders & Stappers, 2013). These bits of information are synthesized rather than shaped into a summary (Martin & Hanington, 2012), and help to avoid the bias behind '*street research*' and get more context of the design situation (IDEO, 2015). Sources should be carefully selected based on their relevance and credibility, avoiding non-peer-reviewed ones, and organized into categories (Martin & Hanington, 2012).

3.1.2 Questionnaire

According to Martin & Hanington (2012) "Questionnaires are survey instruments designed for collecting self-report information from people about their characteristics, thoughts, feelings, perceptions, behaviors, or attitudes, typically in written form" (p. 321).

Questionnaires and interviews are the primary tools for collecting survey information, especially when people are not reachable in person (Sanders & Stappers, 2013). They can be used in various design phases and may be combined with observations to get insights that aren't visible in written responses (Martin & Hanington, 2012).

Questionnaires are easy to create and distribute; however, several factors can affect the answers received and the analysis: question-wording, response options, sequencing, length, layout, appearance, clarity, and instruction (Martin & Hanington, 2012). They can include open-ended questions that provide more in-depth responses, or closed-ended questions that are easier to numerically analyze and communicate. Questionnaires are therefore excellent methods for quantitative analyses (Sanders & Stappers, 2013).

3.1.3 Interview

According to Martin & Hanington (2012) "Interviews are a fundamental research method for direct contact with participants, to collect firsthand personal accounts of experience, opinions, attitudes, and perceptions" (p. 234).

The interview's goal is to connect with people's perspectives; talking with them leads to insights about their mindset, behavior, experiences, and lifestyle (IDEO, 2015; Sanders & Stappers, 2013). Although it is recommended to perform them in person, to analyze interviewees' expressions and non-verbal language, phone calls and social media formats are suitable as well (Martin & Hanington, 2012).

Interviews may consist of a topic checklist or a set of questions (Sanders & Stappers, 2013). They can be structured, with a formal format where topics and timekeeping are constrained, or unstructured, which allows for more flexibility but needs the interviewer's guidance. Their format may as well vary depending on the interviewees: experts in the topic, pairs, or groups; in these cases, it's important to take into account influences between the people involved (Martin & Hanington, 2012; Sanders & Stappers, 2013). Finally, interview challenges include fine-categorizing the results and adapting and being sensitive to the situation of the interviewees (Martin & Hanington, 2012).

3.1.4 Cultural Probe

According to Martin & Hanington (2012) "Cultural probes are provocative instruments given to participants to inspire new forms of self-understanding and communication about their lives, environments, thoughts, and interactions" (p. 119).

Cultural probes use flexible, open-ended, evocative materials to inspire people to consider their context and circumstance and respond to design tasks in unique and creative ways (Martin & Hanington, 2012). They are a fun way to investigate people's lives to find ideas for new designs (Koefoed Hansen & Kozel, 2007). Their goal is to collect inspirational data that stimulate design imagination based on a specific group of individuals or culture (Sanders & Stappers, 2013). They are not intended to be formally analyzed but to extract key patterns and themes. Different materials can be used to shape them, such as postcards, maps, journals, cameras, and recording devices (Martin & Hanington, 2012).

3.1.5   Diary studies

According to Martin & Hanington (2012) "Diaries or journals are guiding artifacts that allow people to conveniently and expressively convey personal details about their daily life and events to design teams" (p. 149).

Diaries collect participants' thoughts, feelings, or behaviors over a specific period. They have an overview of the topic of interest on the front of the format to give context to participants, which is followed by a sample entry. They can be used throughout the day, at the end of it making a summary of the main items, or at particular times when an alarm is set. Diaries can suggest adding sketches, photographs, reflections, or other items as well, in a traditional pen-and-paper format or digitally (Martin & Hanington, 2012).

3.2   Define

3.2.1   Affinity diagram

According to Martin & Hanington (2012) "Affinity diagramming is a process used to externalize and meaningfully cluster observations and insights from research, keeping design teams grounded in data as they design" (p. 19).

Affinity diagrams organize all the information gathered in the previous discovery phase and synthesize it. They involve categorizing the insights into *'affinities'* that have related research themes. One of the variations used is *Affinity diagrams for Contextual Inquiry*, where each of the insights from interviewees is placed on a sticky note, interpreted, and bundled up to create stories about experiences, problems, and people (Martin & Hanington, 2012). Affinity diagrams take a bottom-up approach. Categories shouldn't be predefined from the beginning but rather constructed with the insights from the participants (Martin & Hanington, 2012).

3.3   Develop

3.3.1   Focus group

According to Martin & Hanington (2012) "Focus groups are a qualitative method often used by market researchers to gauge the opinions, feelings, and attitudes from a group of carefully recruited participants about a product, service, marketing campaign, or a brand" (p. 208).

In focus groups, participants are carefully selected and presented to each other as peers, to overcome the fear of being judged and be able to talk about their feelings, desires, and opinions. Focus groups can address different design inquiries such as: reviewing the current state of processes and social relationships, discussing knowledge creation among the members of the group, and unraveling emotions. The designer, who plays the role of moderator and facilitator, has to pay attention to the origin and methods used by the participants to arrive at the information (*e.g. experiences or emotions*). Focus groups are

better combined with other methods to test hypotheses and to explore behavior and attitudes thoughtfully (Martin & Hanington, 2012).

3.3.2 Workshop

According to Martin & Hanington (2012) "Design workshops are a form of participatory design consolidating creative co-design methods into organized sessions for several participants to work with design team members" (p. 140).

Workshops are useful to get insights from the participants through action-based research. They are convenient for participants as they can take place in their workspaces, although they can be time-consuming for designers. Workshops may be used with several intentions such as exploration, generation of ideas, or evaluation, where specific activities are selected. In these activities the designers play the role of facilitators, guiding and supporting the participants. As well, they can teach the basics of design methods to the participants. Designers need to take into account time, logistics, and preparation of materials while remaining adaptable to the changes that may occur during the development of the activities (Martin & Hanington, 2012).

In participatory design workshops participants exchange ideas and knowledge about current experiences and future possibilities, using creative material that can come in many shapes (future workshops, fictional inquiry, forum theater methods, magical props, etc.) They support the mutual learning, democracy, and empowerment commitments of participatory design, as it allows reflection between individuals with different backgrounds (Bødker et al., 2022).

3.4 Deliver

3.4.1 Think-aloud protocol

According to Martin & Hanington (2012) "Think-aloud protocol is a method that requires participants to verbalize what they are doing and thinking as they complete a task, revealing aspects of an interface that delight, confuse, and frustrate" (p. 401).

Think-aloud protocol tests how the participants follow the different processes involved in a product's functioning to know what frustrates, annoys, or pleases them. It is recommended to test independent parts of the functioning to bring specific insights about their use. Although this method is targeted for testing the designer's prototypes, it can as well be used to analyze the competitors in the market.

There are two procedures to carry out this method: concurrent Think-Aloud, where participants verbalize the actions while carrying them out (avoids changing their outcome), and retrospective Think-Aloud, where participants are recorded while performing tasks and later asked to reason their choices while reviewing the tape. This approach is used to learn about the participant's strategy (Martin & Hanington, 2012).

3.4.2 Collaborative prototyping

Collaborative prototyping takes the nature of prototyping in IxD and adds the element of collaboration amongst participants. It implies two challenges: supporting non-designers to express ideas with design material and allowing future users to get hands-on with future technology. Mutual learning is at its core, as designers and participants put their set of skills in common during the process (Bødker et al., 2022).

It is recommended that the collaborative prototyping sessions take place in small groups, with skilled user representatives and in the context where the future technology will be used. It is intended that these sessions count as a learning experience more than a finalizing and polishing activity (Bødker et al., 2022).

3.5 Test

3.5.1 Usability testing

Usability testing consists of qualitative methods that evaluate the experience of users with a digital product, to achieve effectiveness, efficiency, and satisfaction (Alsana et al., 2020; Martin & Hanington, 2012). According to Martin & Hanington (2012) "Usability testing focuses on people and their tasks, and seeks empirical evidence about how to improve the usability of an interface" (p. 432). It bridges the understanding of the system processes between end users and designers. The tests include completing certain tasks to analyze and fix users' frustrations. These tasks are defined user goals with the system and can be complemented with scenarios that help to contextualize. Evaluators gather insights about the length of time, understanding, and suggestions from users during the activity; the Think-Aloud protocol may be used (Martin & Hanington, 2012).

3.6 Design process diagram
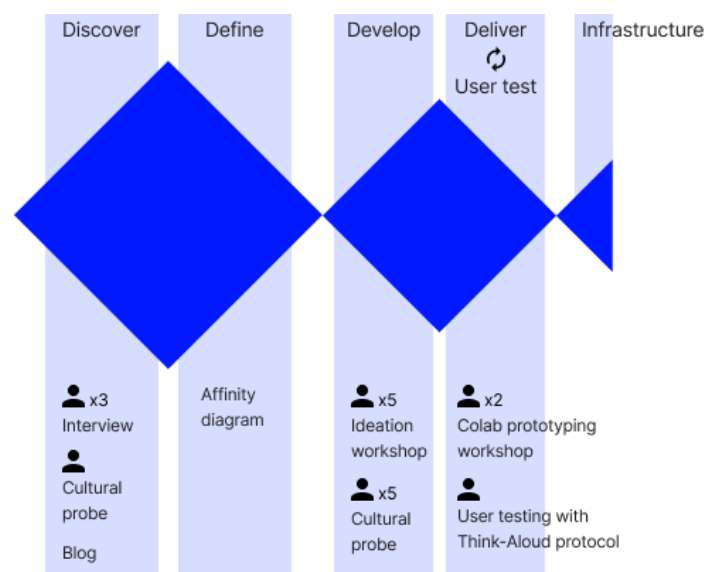
Figure 2. Design process diagram

The design process diagram of this thesis (see Figure 2) is based on the Double Diamond diagram. This diagram represents a linear structure organized in two diamonds, where four design phases are consequent to each other (*The Double Diamond - Design Council*, n.d.):

- Discover: it involves understanding users' situations and problems rather than assuming them. Time is spent with the user to connect.
- Define: it analyses all the insights gathered in the discover phase to frame the design challenge.
- Develop: it encourages solution-finding processes for an already-defined problem. It may involve co-design activities and it draws inspiration from different sources.
- Deliver: it involves testing ideas to narrow them down; some of these ideas are discarded and others are improved until arrival to a final prototype.

Participatory design has been the process foundation. Therefore, all design phases have involved collaboration with participants, including the use of methods tailored for active participation (Martin & Hanington, 2012). Bødker et al. (2022) suggested a design process based on participatory activities (see Figure 3), which this thesis design diagram draws inspiration from; it introduces the phases of infrastructuring and evaluation that are not mentioned in the Double Diamond diagram.

Participatory Design	
Activities	**Purpose**
Field Studies	Understanding practice and initiating mutual learning
Workshops	Facilitating the meeting between diverse stakeholders
Collaborative Prototyping	Collaboratively exploring and developing design alternatives
Infrastructuring	Securing that social, organizational, and technical infrastructures are in place to support sustainability of results
Evaluation	Assessing the outcomes of design

Figure 3. Activities involved in a PD process (Bødker et al., 2022)

4 Design Process

This section describes the design activities carried out to develop the project. All the activities were addressed from a participatory perspective with the collaborators (the elderly museum volunteers), using the knowledge gathered in the *literature review* to adapt the activities for them. These activities are organized among the phases of the design process diagram (discover, define, develop, deliver, user test, and infrastructure), and most of them follow this structure: 1. The rationale behind this step, 2. Suitability for the elderly, 3. Development of the activity and 4. Results and insights for elderly suitability.

4.1 Discover

4.1.1 Collaboration setting

This thesis is based on the collaboration with an association of elderly museum volunteers from Spain. The designer long knew the association and was interested in the benefits of their initiative: to train the elderly as museum guides to promote an active life and to palliate the lack of personnel that most Spanish museums suffer. It was convenient to collaborate with these volunteers as they had the availability to engage in design activities and were motivated to introduce tools to support their work. As well, one volunteer offered to be involved as a *mediator* in the project. The mediator served as a communication channel between the rest of the volunteers and the designer; as a trust creator because she was respected in the association; and as a tester to try the design activities before the rest of the volunteers to validate their suitability for the elderly group.

As suggested by Righi et al. (2017) it was chosen a group of elderly that were not only bonded by their age but by their community. Therefore, the design was based on their community needs rather than their age-related limitations. This draws on the fact that the elderly are a heterogeneous group and have diverse abilities.

Setting challenges

One of the issues that arose when setting the collaboration was the geographical separation with the volunteers, as the designer was settled in Sweden and the volunteers in Spain. Duque et al. (2019) had already problematized the need to propose alternatives to design methods to work with the elderly that were physically separated. In the project, this challenge was tackled from the beginning with several measurements. Knowledge about the communication channels volunteers were familiar with was gathered. All the volunteers used *WhatsApp* and phone calls and they were confident with *Google Forms*. It was also analyzed the possibility of carrying out methods online. Cultural probes could involve tasks using the technologies stated previously. Questionnaires and interviews were easy methods to perform online or by phone call, as they didn't necessarily involve contact between participants or physical materials. On the other hand, workshops usually involved design material or artifacts, which makes it harder to use an online format. However, the mediator could support design activities as a facilitator from Spain.

Figure 4). This was difficult as the selection of activities depended on the insights found during the process (*e.g.* if one interview showed insights about something in particular, more interviews could be carried out in that direction).
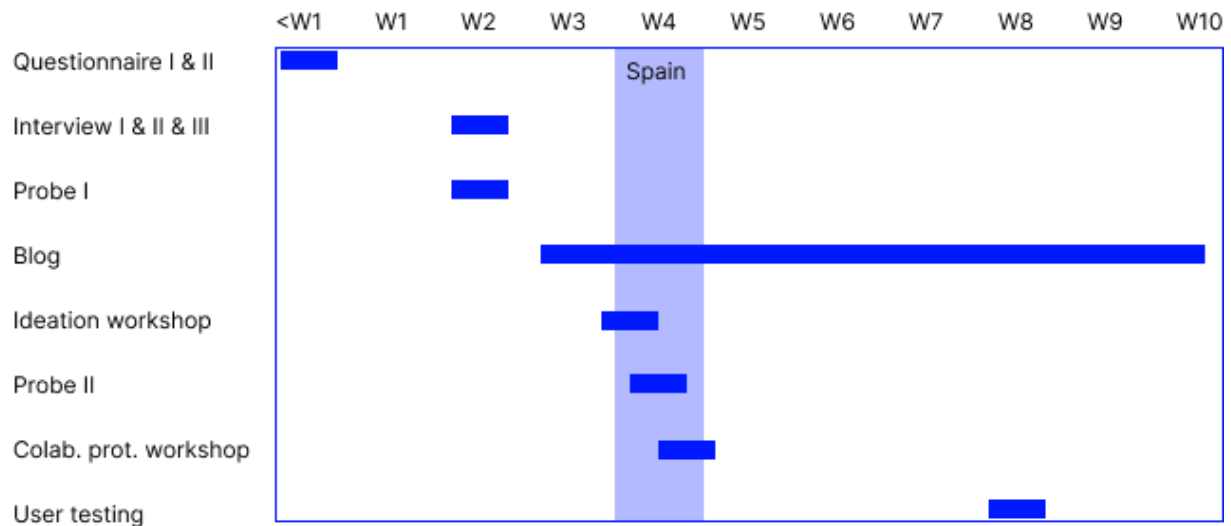
Figure 4. Gantt chart

Communication channel

A *WhatsApp* group named 'Volunteers Project' was created to keep contact with the volunteers during the project development. This group was used to ask specific questions to plan the design activities and to share insights, both for the designer and volunteers. It also served as an introduction for the elderly to the design process, so they wouldn't feel uncomfortable in the collaborative design activities (Demirbilek & Demirkan, 2004).

4.1.2 Blog: Keep participants in the loop

A blog was created using the platform *WordPress*. Its entries contain the development of the project and were written throughout the design process. The link was sent to the volunteers' *WhatsApp* group so they could follow the project's direction.

The rationale behind this step

According to Martin & Hanington (2012), diaries studies allow getting personal information from the lives and events of participants. In the project this idea was twisted around: a designer's diary was set up for the participants to involve them deeper in the design process. The volunteers wanted to know more about the project progress to know that their effort in the design activities was taking shape into a design.

Suitability for the elderly

The blog was created both for the volunteers and researchers or students interested in it, who could benefit from all the development work. Although the blog's design was not specifically shaped for the elderly some interface recommendations were taken into account (a simple navigation menu on the top of the page, avoiding long sequences of actions or moving content (Elguera Paez & Zapata Del Río, 2019)). As well, the designer was aware that the volunteers were skilled in navigating simple webpages to retrieve information for their work.

Development of the activity

The blog entries included the main events of the diverse phases of the project, as well as recommendations to adapt design activities to the elderly. The post publishment started halfway through the design process, due to delays in setting up the *WordPress* page and lasted until the end.

Figure 1. Landpage of the Blog that was created to narrate the design process. The link to access it is: https://www.uxbox.es/

Results and insights for elderly suitability

Most of the volunteers weren't able to navigate the blog. Some thought that the land page was the only part available and they felt disappointed that it didn't reflect the whole process they had been through. Although the designer explained how to access the different entries, it was already at the end of the design process, and the aim of keeping the volunteers updated wasn't fulfilled. As well, many volunteers had forgotten about the blog and hadn't checked it out. It would be recommended for future projects to give reminders to check the blog every time a new entry is available, as well as explain how to navigate it.

4.1.3   Questionnaire: Inspiration toward a participatory process

Initially, the designer proposed two rough ideas to support the volunteers' work based on his experience. Questionnaires were sent to gather knowledge about the interest that the participants had in these topics. However, the insights revealed that the volunteers were

motivated to collaborate in the design process and that they had a lot of ideas to share. Therefore, it was decided to address the project with a participatory approach. The information about these questionnaires is shown in Appendix C. Initial questionnaires.

Questionnaires insights showed that the volunteers had a great appreciation of the cultural heritage in which they were involved and they liked to enrich themselves with visitors' experiences. As well, they received visitors´ feedback that pushed them to keep learning. The majority didn't find difficulties in explaining their cultural knowledge to visitors, as they were passionate about it.

4.1.4   Interviews I & II & III: Insights across the power structure

An interview with a representative of the association's government was carried out on a phone call from Sweden. The interview lasted approximately 1 hour and 30 minutes and covered their aims, vision, and organization from the governance point of view. Afterward, two interviews were performed with two volunteers through a phone call as well. These interviews lasted approximately 1 hour and covered the experience of the volunteers in the museum and as members of the association.

The rationale behind this step

To understand the volunteers' work throughout the different power levels interviews with different representatives were carried out. It was important to contrast the association's needs and vision from different points of view to learn about the dimension of the design (how many users and how many levels could it impact).

Suitability for the elderly

Interviews were the most used method according to a systematic review of participatory design projects with elderly participants (Duque et al., 2019). It is a useful method to get personal insights from participants through direct contact (Demirbilek & Demirkan, 2004; IDEO, 2015). However, these interviews were carried out through phone calls due to the geographical separation. Although video conferences would be an alternative for getting insights from body expressions (Martin & Hanington, 2012), it could be a challenge for some elderly and it was avoided.

The interviews had an unstructured format to avoid constraining the elderly to a fixed answer and using a lot of their memory (Elguera Paez & Zapata Del Río, 2019). The interviews were based on open topics which they could talk openly about and just narrate their lives, keeping an explorative approach.

Development of the activity

Interview I covered general topics related to the organization of the association: the volunteers' profile and the process that the elderly had to follow to become volunteers. These questions had an explorative intention to bring more understanding about the challenges and design opportunities within the association.

Interviews II & III covered different topics inspired by the questionnaires' answers and the insights from interview I. These topics were: 1. Volunteers' motivations; 2. Background; 3. Engagement with the association and activities; 4. On-boarding process; 5. Communication channels; 6. Feedback from visitors and between themselves; 7. Technological knowledge and 8. General problems experienced by volunteers.

Results and insights for elderly suitability

The insights from interview I were categorized into five sections, while the insights from interview I & II were into seven sections. The interviews served to come up with problems, design opportunities, and premature ideas as well. This information is shown in Figure 5. Insights from Interview I, Figure 6. Insights from Interview II, and Figure 7. Insights from Interview III.

Formation:
- Initial formation as volunteer (how museums work, how to work with the staff, rules, security measurements)
- Specific museum formation in the museum
  - Carried by museum staff, veteran volunteers, volunteer created formation books, social media, internet resources (Wikipedia)

Power structure:
Museum staff decides the approach of an exhibition → Volunteers coordinator → Volunteers (freedom to adapt the information they explain, freedom to choose which museum they work in*, with which visitors group & which days)

*Volunteers don't need to adapt to the values of a museum, they go to one that matches them

Tech use:
- The president uses tech to communicate and reach more people
- He is interested in keeping his tasks of mediating in conflicts, calling people, offering the formation to volunteers

Quality control:
- The government team receives feedback from associations, visitors and volunteers
- The president takes measurements to solve issues: volunteers are contacted by phone →volunteers are moved to other museums or expelled

Volunteering:
"Volunteers are there to teach and transmit, not to support teachers"
"Volunteers have freedom"
- **Values:** being active, keep being interested in stuff, being love & supported, get out of home, keep laughing
- Volunteers are a heterogenous group with different level of studies

Problems:
- Volunteers make too long explanations
- Volunteers use innapropriate terms or behaviour
- Need to match the personality & desires of the volunteer to the museum

Design opportunities:
- Expand the concept to other countries
- System that helps the government team organize the association tasks
- System that assigns volunteers to the museums according to their needs & supports mediation when there are conflicts
- Platform for sharing advices, feedback, information, experiences between the volunteers
- Tool to support newbies volunteers in user-centred explanations (substitute the guide manual they have right now for an e.g. app)

Premature idea:
- Visitors feedback in a webpage could serve as quality control of the volunteers
- A section with the volunteers' issues would be useful for the government team to understand the overall situation

Figure 5. Insights from Interview I

Motivation:
- Previous experience as a volunteer guide
- Practice skills, spend more time out of the house

Background:
History bachelor + courses in tourist guiding

Engagement:
- Coming only Wednesdays + when it was needed bc. of her availability
- Other volunteers are more involved

Onboarding process:
- Knows about the volunteering from a friend, goes to the museum in person and asks to join
- Receives a leaflet with basic info. about the museum pieces
- Listens to other volunteers explanations
- Listens to veteran volunteers informative sessions made for newbies
- If newbie wants extra information (up to them): contact curator and ask for documentation

Communication channels:
- 2 WhatsApp groups:
  - Volunteers + manager: to inform about reservations
  - Volunteers + museum president: to organize social activities
- Meetings every 2 months: discuss & ask questions
- Groups and individuals make reservations for guiding calling to the museum

Tech usage:
- Some volunteers use tablets to show pictures
- Some volunteers use paper based pictures
- Some old volunteers (+76) don't have the skills to use tech mediums (webpage, tablets, etc)

Feedback
-

Problems:
- There is a lack of communication of new formation programmes for volunteers or new functions the museum is going to add
- Information displayed in the museum is paper-based and only available in Spanish

Design opportunities:
- There are weekly kids visits
- Ongoing project of a webpage to give visibility to volunteers
- Improve paper-based feedback system (adding an alternative digital solution)
- Volunteers don't attend each others explanations, so there is no feedback system between them

Figure 6. Insights from Interview II

Motivation:
- Interest in history
- Formation in humanities but never had experience as a guide

Background:
Finance sector

Engagement:
- Coming 2 days/week
- Organize talks

Onboarding process:
- Knows about the volunteering from a the Alhambra webpage, goes to the museum in person and asks to join
- Receives a leaflet with basic info. about the museum pieces
- Guiding formation manuals sent from CEATE
- If newbie wants extra information (up to them): has to stay updated in coming events

Communication channels:
- 2 WhatsApp groups:
  - Volunteers + manager: to inform about reservations
  - Volunteers + museum president: to organize social activities, share news, expositions, seminars
- Fb, tw of the Alhambra museum

Design methods:
- Prototype each feature of the webpage with a different volunteer, so that the volunteer becomes proficient at that feature
- Volunteers can later explained their features to each other
- This way, the structure where volunteers learn from volunteers is mimicked

Tech usage:
- Volunteers are proficient in WhatsApp

Feedback:
- Current paper-based feedback format doesn't work because visitors don't take the time to fill it in. Volunteers are ashamed of it.
- Volunteers suggest visitors to give feedback in the fb page
- Feedback between volunteers is based on doubts about pieces information. Only small comments. Usually the president or person with the most knowledge is consulted

Premature idea:
Forum where each volunteer is an expert in something and other volunteers can ask specific questions publicly

Problems:
- Organization of the volunteers that attend each day (sometimes there are not enough present)
- Bad communication with 'Patronato de la Alhambra'

Design opportunities:
Webpage project
- Give visibility to volunteers' work
- Show pride about their work (stats)
- Doubt: How do volunteers involve in it?

Premature ideas for Webpage functions:
- Posts with the activities organized daily
- Feedback system volunteer-volunteer & visitor-volunteer
- Organization of attendance
- Demands to properly do their work (soft power to pressure Patronato to talk to them)
- 2 interfaces: towards the visitors, towards volunteers

Figure 7. Insights from Interview III

It's important to take into account the duration and conciseness when planning interviews. The interviews described previously had an unstructured format, which led the elderly to derail from the topics to cover and talk about other experiences. For example, in interview I the elderly explained the history of America, because that was his work in the museum, rather than focusing on the questions. This implies long interviews. The reason for this could be the lack of concentration associated with age (Demirbilek & Demirkan, 2004; Elguera Paez & Zapata Del Río, 2019) or the desire of being listened to because they don't usually have that opportunity (Duque et al., 2019). Therefore, unstructured interviews should be supported by the interviewer to keep the conversation on track, and structured interviews should have freedom in the answer and enough time to don't stress the elderly.

As well, technical terms can be a challenge for the elderly. One of the interviewees was proficient with a lot of social media formats (blogs, *Instagram, Tik Tok*, etc) and could give insights about how technology could impact the association using digital terminology (*e.g.* platform, automatization of processes, feedback, etc.). However, the other two interviewees

were less aware of this terminology, and it was difficult to address some of the technical concepts with them.

The main insight from the interviews was the diversity of needs across the structure of the association. The top power wanted to spread the association format to other countries; the bottom volunteers wanted to promote and make themselves visible on their scale. It would have been interesting to design a solution that could benefit directly both levels of the organization, but as their demands were different it wasn't suitable.

4.1.5 Cultural probe I: Problematize the context

A cultural probe was carried out with one of the volunteers to know her work experience. She was instructed to document the problems she found and sent the information through *WhatsApp*. However, the insights gathered concerned the outdated communication format of the Museum, which concerned visitors' experience more than the volunteers' work. Therefore, the probe didn't impact the design process. This activity development is further explained in Appendix D. Cultural probe I.

4.2 Define

4.2.1 Affinity diagram

This method was carried out by the designer alone. The elderly were not involved because of the big amount of information to analyze and categorize and the lack of means to do it through the technologies they already knew.

All the information gathered from interviews I, II & III was transcribed into sticky notes in *Figma*. Then these bits of information were grouped into categories. The theory states that the affinities shouldn't be predefined from the beginning but rather come up from the synthesis process (Martin & Hanington, 2012). This is fulfilled in interview I but not in interviews II & III, where all the insights were grouped into the categories of the questions because it was the best matching possibility. The affinities in interview I were: formation, power structure, technology use, quality control & volunteering. The affinity diagram result was already shown in Figure 5, Figure 6, and Figure 7.

4.3 Problem definition

The process of synthesis of the information gathered through the affinity Diagram led to the outline of a design opportunity. One of the ideas that came out from the interviews was that the volunteers had the desire to create a webpage to promote the activities they did and to be recognized by the public. This idea was discussed in a volunteers meeting and they agreed it was something important to create; however, they felt unable to address the challenge by themselves, as they didn't have enough technical knowledge. Therefore, this was an opportunity to design.

The synthesis of the information showed that there were a lot of possibilities for functions for this webpage. These functions would not only make the volunteers' work visible but

would further help them with other aspects. Therefore, the design opportunity was a *platform* that could have some of the following topics:

1. Feedback from museum visitors
2. Learning system: information sharing, archiving
3. Organization of volunteers: shifts, channels of communication, reservation system, mediating conflicts
4. Advertisement and value enhancement of volunteers' work: activities, experiences
5. Communication with public entities: needs & desires

These topics were vaguely defined, as they were an outline for the volunteers to ideate and prototype. In the following collaboration activities, they could change and extend them in their desired direction. However, it was easier to set some foundations to work with to not overwhelm the volunteers with too many choices. The design was defined as a platform as it would be an intermediary of digital content between the volunteers, with the freedom for all to add UGC and where discussions could flourish around the concerns of the association. It would consist of a space where users could build content that could involve zero-code programming (Gillespie, 2010). In addition, the design of the platform would follow a participatory approach, increasing the democracy of volunteer decision-making.

4.4 Develop

4.4.1 Workshop I: Ideate with a focus group

A group of volunteers participated in an ideation workshop carried out in person in Spain. This workshop consisted of a series of activities based on the previously selected topics, to further discuss them and find ideas to shape the volunteers' platform. The workshop took place in an office for approximately 2 hours and 30 minutes.

The rationale behind this step

Once settled in Spain it was important to gather the volunteers and meet them in person to talk about the development of the project. Although they had been updated about the decisions taken and the synthesis results through *WhatsApp*, was needed further discussion about the idea of the platform and what they would include in it.

Suitability for elderly

A focus group was created to participate in the workshop activities, sending an invitation with a brief description of the workshop's aim through *WhatsApp*. The volunteers could decide freely to participate; this way they wouldn't feel pressured or uncomfortable. In focus groups participants are peers so there's no fear of being judged (Martin & Hanington, 2012); that happened in this activity as the participants were already friends, leading to a comfortable environment for social interaction (Demirbilek & Demirkan, 2004; Sanders & Stappers, 2013).

The activities were bundled into a collaborative workshop, where the designer was the facilitator to support the elderly. This allowed the exchange of knowledge (technology-association organization) and contributed to the mutual learning proper of participatory processes (Bødker et al., 2022). There was no time constraint and the activities remained flexible to changes (Sanders & Stappers, 2013). However, the facilitator kept the activity on track if it was derailing from the main topic (Sanders & Stappers, 2013). As suggested in theory, the materials involved were traditional ones (paper, pen, tape, etc.) rather than technology-based (Demirbilek & Demirkan, 2004; Häikiö et al., 2007), and the activities offered a diverse use of them (de Podestá Gaspar et al., 2018).

Development of the activity

Workshop I consisted of three exercises, each of them related to one of the platform's topics discussed previously in Problem definition. However, two topics were left out of the activity. '*Topic 3. Organization of volunteers: shifts, channels of communication, reservation system, mediating conflicts'* was not addressed because it was not the volunteers' priority and it involved a greater technological challenge in its use. As well, *'Topic 5. Communication with public entities: needs & desires'* was addressed with a cultural probe because some volunteers that couldn't attend the workshop I wanted to still participate in the design process.

Each exercise of the workshop was preceded by a warm-up exercise to discuss the need for that topic in the platform. In the first exercise, participants had to reflect on the importance of receiving feedback from museum visitors, as well as the kind of information that would be useful to receive. Likewise, different examples of feedback adapted to their context were presented and it was proposed to create their own with some predefined templates. In the second exercise, the participants were presented with an invented museum object. They had to explain how and by which steps they would find information about it. Subsequently, these steps followed in the analog world would be translated into digital. Finally, in the third exercise, participants were presented with a fictitious newspaper called *'Volunteer Diary'* as inspiration to reflect on the type of news that the participants would like to share with the public. The activity included some examples of news, as well as blank formats to offer freedom of choice. Each of the volunteers had to fill in an entry with an example of something they wanted to share. Figure 8, Figure 9, Figure 10, and Figure 11 show the materials designed for this activity and its outcome.

Figure 8. Exercise I material: examples of digital feedback

Figure 9. Exercise II material: Museum-invented object

Figure 10. Exercise III material: examples of news

Figure 11. Workshop I: volunteers and outcome

Results and suitability for elderly

In the first exercise, volunteers concluded that it is important to receive feedback to support their self-esteem, to continue learning, and increase their commitment. In addition, they agreed on the use of 5 different feedback formats:

- Comments with Yes/No answers: to ask about the duration, recommendation of the visit, knowledge about the work of the volunteers, and visiting hours.
- Comments with an open response: to ask about specific pieces, the visit in general, and what they liked the most.
- Comments with scale: for questions about the visit in general.
- Star-rated feedback: for questions related to the topics of the explanations.
- Comments in the form of multiple answers: to ask about the relationship between the pieces of the museum and history. Ask about preferences such as ceramics, architecture, etc.

In the second exercise, the volunteers discussed the sequence of actions they would like to follow to find information about a specific piece. They would first search the piece by keywords, identify the image that corresponded to it, and access the page. The piece page should contain a link to the museum's blog with information about this piece, information from their basic and extensive guides, and from volunteers expert in the piece's category (a checkbox to select if the president of the museum had approved the information was also needed). It should contain as well the sources of information, images, articles, videos, and questions from other volunteers. They also discussed that they wanted this information digitally and on paper. In the third exercise, volunteers wanted a static page with general information about the association and to write content about four different categories: events, talks, activities, and museum content.

As well, the synthesis of this workshop development brought recommendations to carry out design activities with the elderly, which are proposed in

Table 1.

Domain	Recommendation
Skills	Support participants in manual activities (*e.g.* writing) For example, in the workshop, the participants did not want to use their writing because they said it would be difficult to understand. Häikiö et al. (2007) also suggested avoiding elderly handwriting because it can be unreadable, but the role of the facilitator can overcome this issue by offering help to the elderly.
Activity monitoring	Maintain an open structure that gives rise to dialogue and creativity, but try to steer the conversation in the desired direction. Do not pressure the participants by controlling the time and suggest that everyone give their opinion. For example, in the workshop, some participants talked too much and didn't leave enough time for others to express their concerns. Therefore, the activities took too long and didn't encourage everyone to participate.
Use of technology	Participants who are not technologically savvy tend to stick with the digital formats that are presented as examples. This could be due to their fear of experimenting with technology. The designer has to try to guide them to create their content. For example, in the first exercise, the participants didn't create new formats to present feedback but rather criticized the ones presented and copied them. It's also important to explain digital terms. For example, the participants don't understand a digital format in the same way as digital natives, such as the use of a questionnaire to give feedback or public and private content. Nor do they understand how an analogical process can take shape digitally. It's beneficial as well to use traditional formats as material for design activities. For example, the use of the newspaper in the third exercise helped the elderly understand what could be published on the platform, instead of confronting the challenge without a reference.
Participation	Engage participants with issues that concern them. For example, choosing topics that were motivating for the elderly made them focus more on the activity.

Table 1. Recommendations to plan design activities for the elderly based on Workshop I

4.4.2   Cultural Probe II: Claim volunteer's needs

A cultural probe was sent to volunteers through *WhatsApp*. The design material for this probe was presented in *Google forms*, a format the volunteers were already familiar with. Answers were collected for one day.

The rationale behind this step

Some volunteers wanted to collaborate in the ideation process but couldn't attend workshop I. Therefore, I decided to use a cultural probe to bring inspiration about a controversial topic. Section *5. Communication with public entities: needs & desires* of the platform came from the insight that the public institutions that managed the museum didn't take the volunteers' needs into account. Volunteers regarded their work as an added value to the museum and therefore, wanted to be recognized for their labor and be supported in it. However, the museum management had recently reduced their benefits and hadn't answered their demands. Therefore, it was an opportunity to use the platform to state their needs. This was a premature idea and it had the intention to make the volunteers reflect on their current situation and explore the possibilities of using their platform for that purpose or a similar one.

Suitability for the elderly

The suitability of probes and their adaptation for the elderly are the same as in the cultural probe I but with the use of *Google forms* instead of *WhatsApp*. Cultural probe I is shown in Appendix D. Cultural probe I.

Development of the activity

The cultural probe was divided into three sections. The first one was a reflection on the available communication means to express volunteers' needs. The second one included the study of an example of a platform to share needs publicly, *Change.org* (*The World's Platform for Change*, n.d.). Finally, the last part was inspirational to come up with the desired format to express volunteers' needs in the digital world.

Although sending a form to participants may seem different from the traditional approach of a cultural probe, it was shaped in a similar way and with the same intention. The form included evocative material to make participants reflect on their experience and bring inspiration to designers, as in cultural probes (Koefoed Hansen & Kozel, 2007; Martin & Hanington, 2012). The example of the platform *Change.org* were people can expose their demands and get support from others, was used to explore new, digital ways of showing volunteers' needs to the public. It served to make volunteers reflect on their situation in the context of the museum and share it with the designer. The cultural probe material is shown in Appendix E. Cultural probe II.

Results and elderly suitability

Volunteers didn't want to publicly share their problems or otherwise change their communication channels with public institutions. This needs to be resolved within the

association. However, they want to have more visibility, especially from the museum institutions through the dissemination and value creation of their work.

As well, the synthesis of this cultural probe development brought recommendations to carry out design activities with the elderly. It's important to use technology already known by the elderly. It was useful to employ a format the volunteers were already familiar with. For example, screenshots of the interface of *Change.org* were added to the form, followed by an explanation of its functions, so the elderly wouldn't have to face the challenge of navigating this platform and getting lost. As well, it's relevant that the participants trust the participatory process. The answers to the form were diverse, but some of the volunteers strongly disagreed with sharing their desires publicly and they were worried that this function would be finally included in their platform. The intention behind this cultural probe was to reflect and inspire the designer to come up with ideas, rather than definitively defining a section that wouldn't support elderly choices. As suggested in theory, the elderly feel like they can't control technology development and that choices will be taken without their consideration (Duque et al., 2019); therefore it's really important to create trust in the participatory process with the participants.

4.5 Prototyping

4.5.1 Workshop II: Collaborative prototyping

Workshop II had two parts. One was carried out in the house of one of the volunteers and the other one at the museum. The first involve navigating the volunteer's personal facebook page using the Think-Aloud protocol and the second involved drawing the interface of two of the sections of the platform in collaboration with the elderly, to decide the basic navigation and elements of the it. The workshop lasted in total approximately 45 minutes.

The rationale behind this step

The elderly find it difficult to adopt new technology because interfaces are not adapted to their age-related limitations, such as visual, psychomotor, and cognitive deterioration (Häikiö et al., 2007). Some researchers support the collaboration of the elderly in interface design to better account for their needs (Elguera Paez & Zapata Del Río, 2019). Therefore, it was important to bring the volunteers into an activity to craft it together. Two volunteers were selected for this workshop based on their fear and low consumption of technology. The intention was to test if the collaborative workshop would bring more acceptance in technology, and therefore, better use of the platform. Each of the volunteers prototyped a different section, to become an expert in its use, and later show its use to their peers.

Suitability for elderly

The Think-aloud protocol was a useful method for the elderly. To address the interface design it was important to understand how this aged group understands and feels the digital interfaces when they were navigating them. It was chosen the Think-aloud concurrent procedure, where participants verbalized their actions in real-time, instead of looking at a

recorded tape, so the elderly wouldn't have to rely on their memory (Martin & Hanington, 2012). As well, recommendations were taken into account such as using technology already known by the elderly (*facebook*), no pressure of time, support during the activity, and using a safe space like their home (Sanders & Stappers, 2013).

The collaborative workshop was performed with pen and paper, which was a familiar material for the elderly (Duque et al., 2019; Häikiö et al., 2007), and which served as the medium for them to shape the future use of the platform. As recommended in theory the sessions took place in small groups, in the context where the future technology will be used. Although Bødker et al. (2022) suggested using skilled user representatives, the designer did the opposite. The intention was to gather volunteers with a fear of using technology and analyze the effects of this workshop on their acceptance of technology.

Development of the activity

In the first part of the workshop, the volunteer had to navigate through *facebook* and use the Thnik-aloud protocol to state every action or emotion that came to her mind. This was helpful to understand how the volunteer understood the semiotics and architecture of the interface.

In the second part of the workshop, the volunteers had to imagine they were navigating the archive and the advertisement sections of the platform and describe their appearance. The facilitator offered support with the use of a flow diagram of the different screens that needed to be designed as well as pen and paper to draw the pages. Figure 12, Figure 13, and Figure 14 shows the outcomes of the workshop.

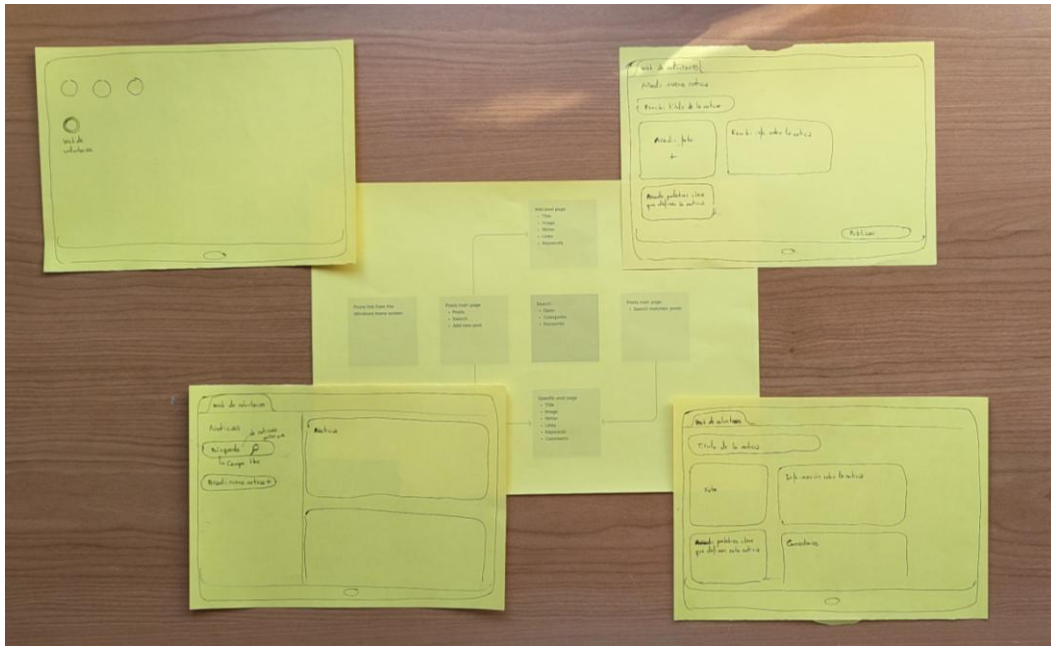Figure 12. Development of the Collaborative prototyping workshop

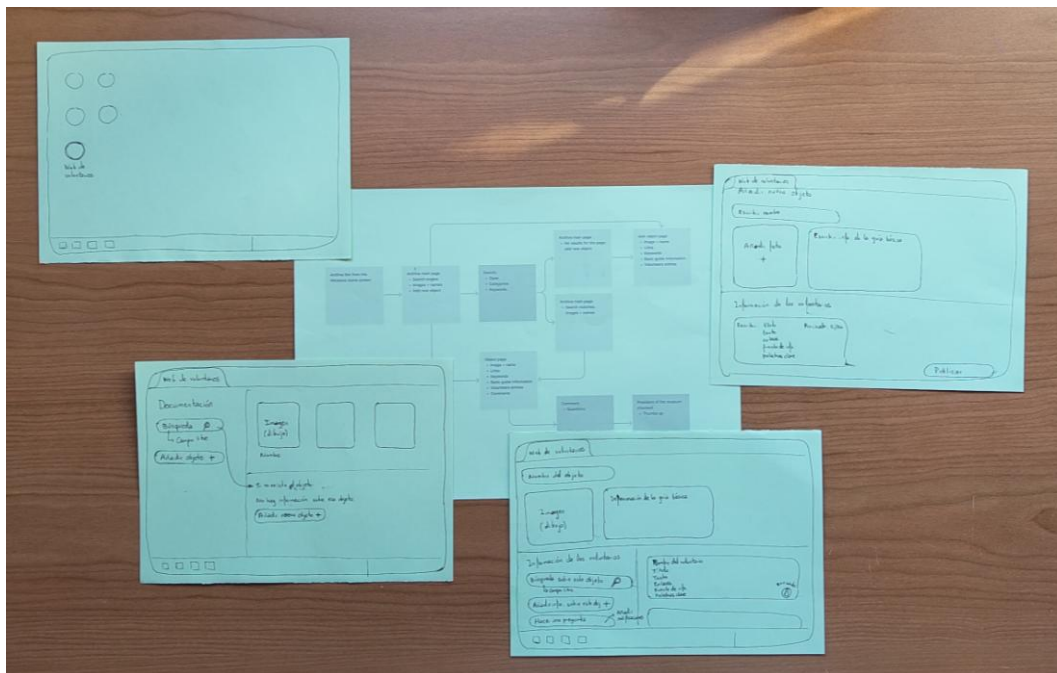Figure 13. UI prototype for the Advertisement section

Figure 14. UI prototype for the Archive section

UI insights Part I
- Prefers links to access the page
- Follows the written feedback of what to do (e.g. when in a text entry is written: Comments here...)
- Understands basic emojis (e.g. thumbs up)
- Guides herself with images and names
- Needs intuitive processes with a lot of feedback (no memorizing)
- Needs the Back arrow icon (to come to a known page)
- Likes Posts format

UI insights Part II
- Use different devices (phone/computer/tablet)
- Shortcut from desktop to the different functions of the platform
- Use specific terms for functions (e.g. noticia instead of post)
- Need support for using tags (didn't understand how to use them)
- Prefer open format to search for information (no filters)
- Issue: Who creates initially each object entry? Who adds the basic guide information?
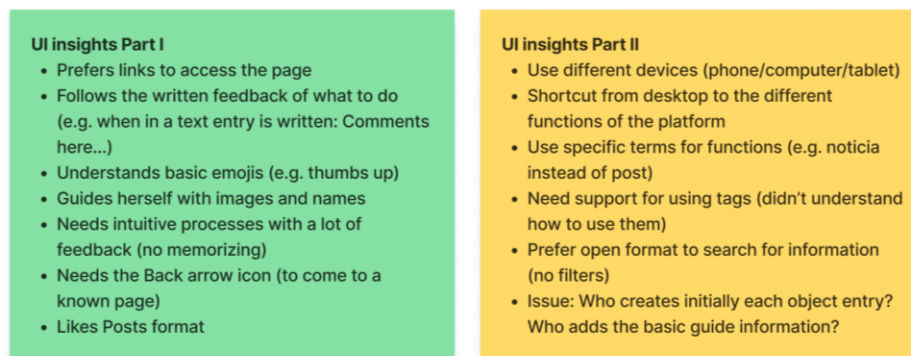
Figure 15. UI insights from the Collaborative prototyping workshop

The interface design insights gathered after the workshop are shown in Figure 15. In addition, the synthesis of this workshop development brought recommendations to carry out design activities with the elderly. For example, it's important to find an appropriate setting to carry out the design activities. Although the workshop was carried out in the volunteers' workspace, it wasn't suitable, as there was not enough room and the volunteers were time constrained because they had to go back to work. This led to a fast-paced activity where participants couldn't properly use their skills and memory, as well as felt overwhelmed by the amount of work to be done. As well, the volunteers had to be reminded of insights from the previous workshops because they had already forgotten about them. Therefore, information retelling the steps of the design process should be offered as support during the workshop.

An introduction to interfaces should be given as well. During the workshop volunteers felt lost with the concept of user interface and its elements (*e.g.* they didn't understand what keywords were and how they could help them). They needed a lot of guidance to create the different pages as well. Showing some examples or explaining the basics before could have improved it. Another issue was that paper prototyping felt far away from an actual digital interface, as volunteers couldn't interact with the different elements and see changes. Prototyping in *Figma* would need testing.

4.6 Prototype

Only one of the prototypes created in collaboration with the volunteers in pen and paper was shaped digitally in *Figma* due to time constraints. The archive section was selected because it was important for the volunteers. As well, the volunteer who participated in the prototyping workshop was easier to reach for later user testing.

Different sources were taken into account to design it: insights from the collaborative prototyping and ideation workshops, as well as from literature review, and inspiration from *WhatsApp* and *Google form* interfaces (as the elderly were familiar with them). All the information gathered from these sources is shown in Figure 16.

Insights from the Collaborative prototyping workshop
- Add shortcuts to sections of the page
- Add feedforward directly into the buttons and text-entry boxes
- Use basic emojis (e.g. thumbs up)
- Navigation with images
- Needs intuitive processes with a lot of feedback (no memorizing)
- Needs going back arrow (to come to a known screen)
- Posts format
- Use of different devices (phone/computer/tablet)
- Use specific terms for functions (e.g. noticia instead of post)
- Use text-entry search for information (no filters)

Insights from the Ideation workshop
Inside each object's page it's needed:
- Monument museum's blog with the information of the object
- Information from the basic guide
- Information from the long guide (if the president of the museum allows it)
- Information from the volunteer expert in the object
  - Add information references
  - Be able to add articles, images or videos
  - Other volunteers can ask questions about the piece
  - Museum president can approve the content to give more validity
- Be able to have all this information as well on paper (print option)

Insights from Literature review:
- Big size for font and icons. Thick tipography. Allow font size adjusting
- Wide spacing
- Easy to understand buttons
- No moving elements
- No long sequence of actions. No unfamiliar actions.
- Simple menu structure
- Icons with labels. Significant icons. Different icons for different functions.
- No pop-up windows
- Use of traditional pressing buttons
- Concise text
- Offer help
- An expert can manage the accounts
- Information in the center of the page, no scroll buttons, no time restrictions to do tasks
- No drop down menus, consistent localization of navigation, back arrow
- No hyperlinks inside the text
- Linear process
- Color buttons. Use coloured boxes only for this purpose
- No personal data when signing-up

Insights from Google questionnaire
Use this format for the functions of 'add new object' and 'add information about the object'

Insights from WhatsApp
- Copy icons (double tick, send)
- Use this format for the Q&A section

Figure 16. Insights to design the Archive UI

Houde & Hill (1997) designed a triangular model to represent prototyping intentions. These intentions were role (how an artifact is useful to the user), look and feel (user's sensory experience), and implementation (technical details to work).

In this case, the archive prototype was halfway between role and look and feel (see Figure 17) because its functionalities, the organization of information, and navigation responded to the needs of the volunteers, and because it showed the feel of the final interface. The prototype intended to test that the choices made by the volunteers during the participatory activities were reflected in the design of the platform and that the collaborative prototyping workshop helped the elderly users to intuitively navigate the interface, without the fear of feeling lost.
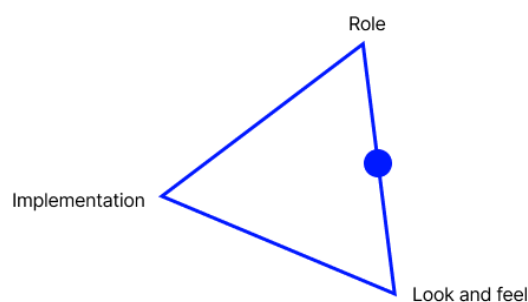

Figure 17. Archive prototype in the model by Houde & Hill (1997)

4.7 User testing

The prototype of the archive section crafted in *Figma* was tested with one of the volunteers. This user testing consisted in navigating this function following a series of tasks, using the Think-aloud protocol. These tasks consisted in:

1. Adding a new piece that was not registered
2. Adding information about the just added piece
3. Answering a question about the just added piece
4. Visiting a piece of information added by a volunteer
5. Navigating back to the initial archive land page

This testing wasn't specifically shaped for the elderly, as it had two intentions: 1. Testing if all the collaboration with the elderly had brought acceptance and understanding of the final design of the archive section; 2. Testing flaws in the interface design: navigation, labels and semiotics, organization of content, missing elements or steps. The insights from the activity are shown in Figure 18.

Insights task I:
- Confusion about how Add a new piece works. Isn't that information already there, do they have to add it? Organizational issue.
- Size adjustment was easy to understand. User found it useful
- Confusion between labels in uploading image function
- Where are those images going to be displayed?

Insights task II:
Confusion between labels in uploading image and documents function. What document do I have to upload?

Insights task III:
- Add a button saying 'Send' rather than the arrow in the questions section
- Choose the person to notify to on WhatsApp
- Have a WhatsApp notification as well if someone answers your question

Insights task IV:
Add a button labeled 'See information'

Insights task V:
Easy Menu navigation. Also convenient to have the go backwards arrow

Figure 18. Insights from user testing

4.8 Infrastructuring

This term refers to the activities carried out between designers and stakeholders to create infrastructures that ensure that the project work will continue (Bødker et al., 2022). In the case of this project, the infrastructuring process is settled on three pillars: the blog, the recommendations to plan design activities with the volunteers and the archive prototype.

The blog contains all the information gathered from the activities with the volunteers. It was initially created as a method to keep the volunteers aware of the development of the design process, but it has become an archive of the mutual learning that happened between the participants and the designer. It is written in a way that it's easy to understand for elderly users, so they can use it in the future (Bødker et al., 2022). It also includes all the information gathered about engaging these elderly volunteers with design activities and establishing a

prolific collaboration. This information may be used in further design methods with them. On the other side, the archive prototype can be coded by a team of developers and bring it to reality. It can serve as well as an example for the design of the other sections of the platform.
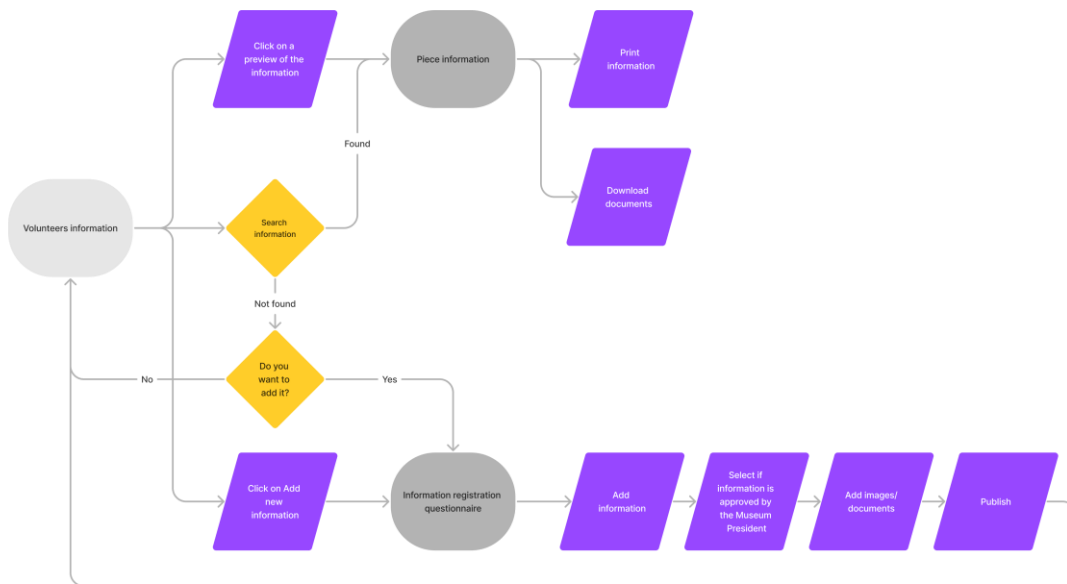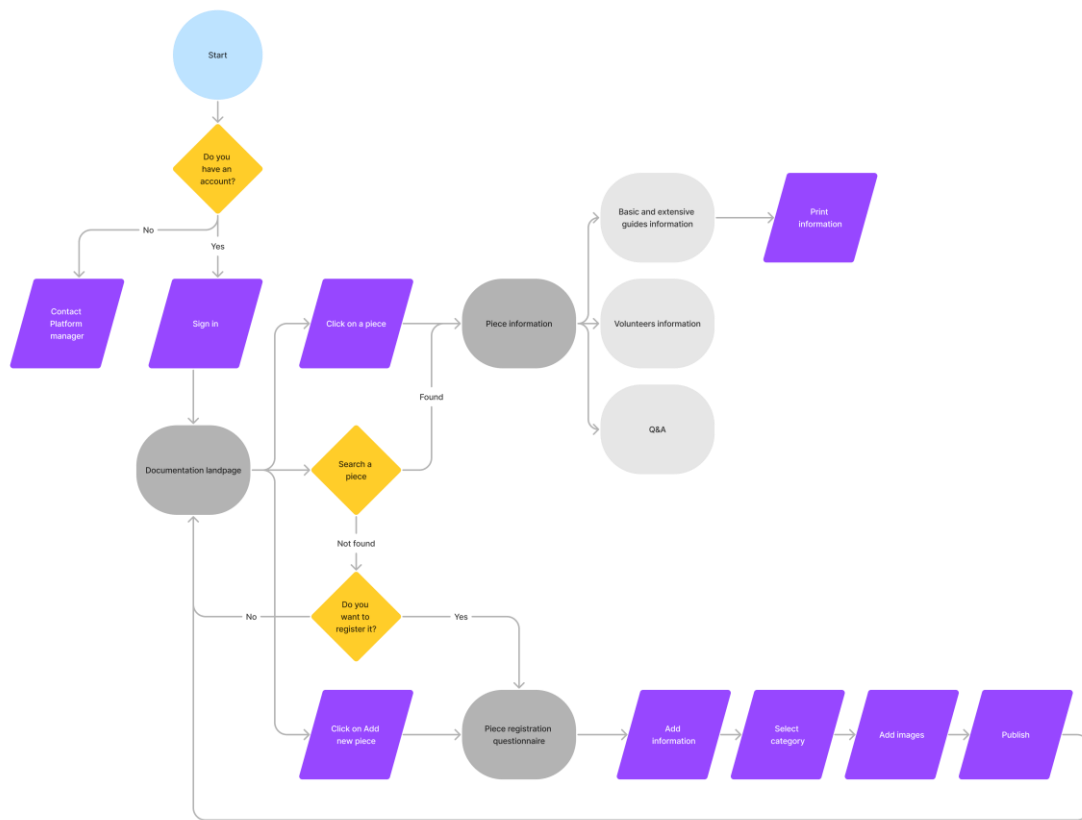
5 Main results and Final design

5.1 Platform design

The association has an organized structure, where different actors play specific roles in it. The design of the platform takes those roles into account, gives them special attributes in the digital world, and assigns them actions. The following text explains the design of the platform in terms of those roles and functions, and the level of refinement that each section has reached in the design process.

5.1.1 Archive

The archive is a private part of the platform available for the volunteers. It stores information from the museum pieces added by the volunteers to serve as guiding for new volunteers and to avoid losing the data over volunteers' generations. A user flow diagram is provided to understand the system (see Figure 19). The final prototype of the archive can be tested in *Figma*.

As mentioned in Prototype, several sources influenced the design of the archive's user interface. The structure is based on the elders' choices as well as the influence of interfaces they were familiar with: the Q&A mimics the design of a WhatsApp chat, or the questionnaire to add a new piece or information about an existing piece is inspired by Google forms. The colours are also a mixture of personal preferences and influences from these interfaces. The typography is Roboto, chosen for its legibility on screen and displayed in different sizes to match the hierarchy of information. Another notable feature is the drawings that represent the museum pieces, which are included as such because the volunteers can't use photographs to identify the pieces for legal reasons.
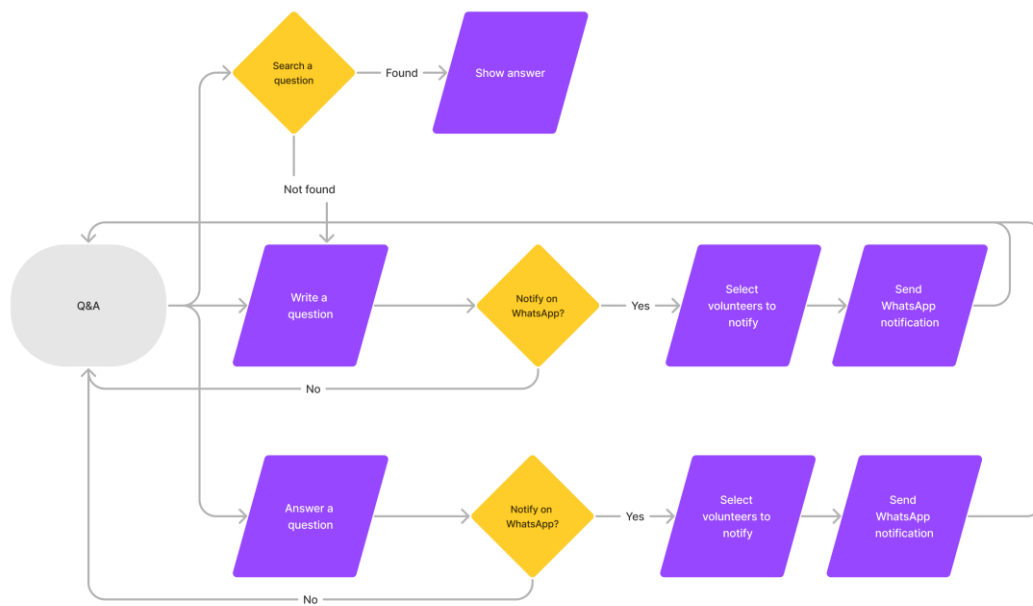
Flowchart 1

- Start
- Do you have an account?
  - No → Contact Platform manager
  - Yes → Sign in → Documentation landpage
- Documentation landpage → Search a piece
  - Found → Click on a piece → Piece information
    - Basic and extensive guides information → Print information
    - Volunteers information
    - Q&A
  - Not found → Do you want to register it?
    - No → Documentation landpage
    - Yes → Piece registration questionnaire
- Click on Add new piece → Piece registration questionnaire → Add information → Select category → Add images → Publish

Flowchart 2

- Volunteers information → Search information
  - Found → Click on a preview of the information → Piece information
    - Print information
    - Download documents
  - Not found → Do you want to add it?
    - No → Volunteers information
    - Yes → Information registration questionnaire
- Click on Add new information → Information registration questionnaire → Add information → Select if information is approved by the Museum President → Add images/documents → Publish

Figure 19. User flow diagram of the Platform Archive

Design process

Affinity diagram → Ideation workshop → Collaborative prototyping workshop → *Figma* prototyping → User testing

Roles

- President of the museum. The president usually checked the information that the volunteers gathered themselves and approved it. The president is not a user of the platform because is not part of the volunteers' team, but the volunteers can mark that their information was validated by the president to get more credibility.
- Manager of the platform. This role's attributions would be creating accounts for the new volunteers, as well as reporting problems in its functioning. The secretary of the association could take this role as he was interested in getting more engaged with the platform and he's already an expert in managing problems inside the association. However, further discussion would be needed.
- Expert in the field. The pieces in the museum are categorized into groups (pottery, sculptures, rrabic writing, etc.) that have experts assigned. Volunteers may ask specific questions to these experts.
- Content creator. The rest of the volunteers would add information to the archive enriching it.

Actions

Add an unregistered piece

All the pieces that are already in the basic guide of the museum would be automatically created in the archive. All the new pieces that come to the museum or that volunteers want to keep in the archive would be added by themselves. To add them, they have to fill in a simple questionnaire regarding the information they have about it (see Figure 20).
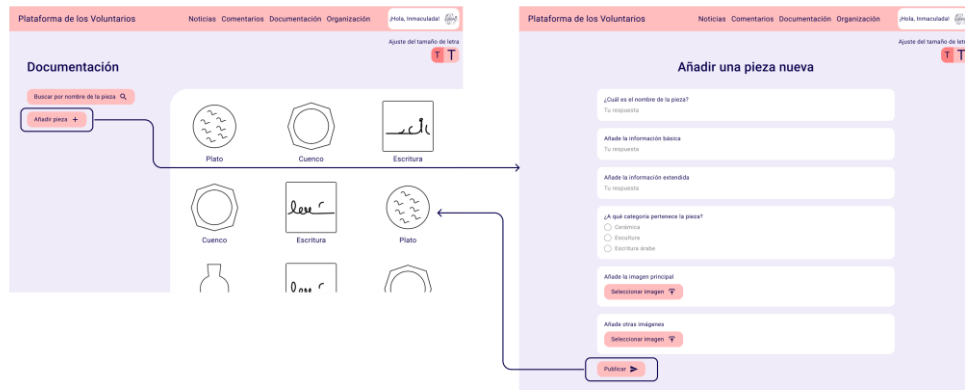
Figure 20. Wireflow: add an unregistered piece

Add information about an already registered piece

Experts in a specific field and content creators can add information about all the different pieces. To do that they have to navigate to the specific piece and fill in a simple questionnaire, where they can upload images and documents as well. If their information has been validated by the president of the museum they can mark it (see Figure 21).
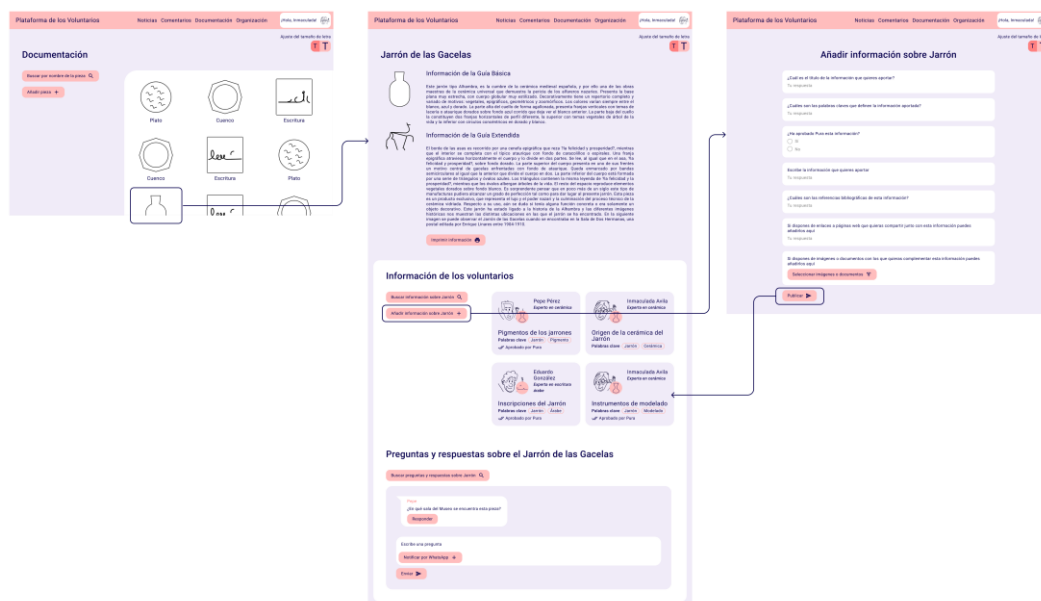
Figure 21. Wireflow: add information about an already registered piece

Search for information about a piece

All volunteers can look for information about a piece. On the land page, they can select the desired piece from a panel with pictures and names or they can use a search bar. Once on the piece page they can read information from the basic and extensive guides or check the information added by volunteers. This section with the volunteers' information offers a search bar as well as previews of the pieces of information. Once selected one of these pieces, information about the volunteer who wrote it is displayed (name, picture, and expertise) as well as the information added. Both the information from the basic and extensive guides and the volunteers' can be printed (see Figure 22).
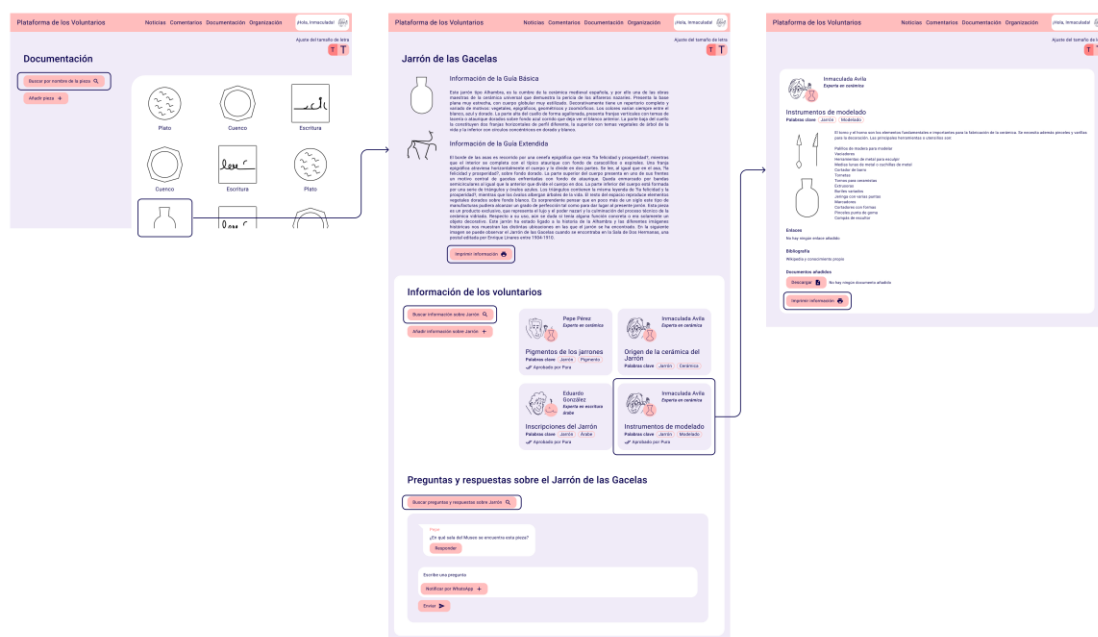
Figure 22. Wireflow: search for information about a piece

Q&A about a piece

Volunteers can ask questions about a specific piece. To do that they have to navigate to the Q&A section on the piece page and write a question in a chat. They can address this question to a specific volunteer or choose the predefined option of the expert in the field of the piece, who would get notified on *WhatsApp* to answer the question. All volunteers can answer questions; when volunteers get an answer, they are notified in *WhatsApp* as well (see Figure 23).
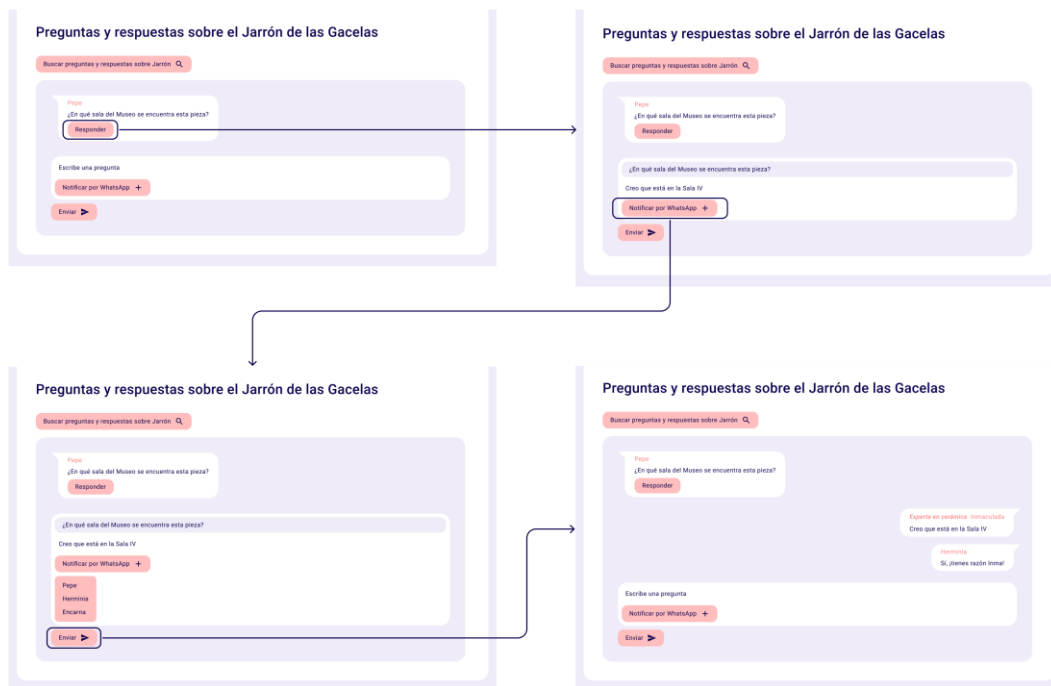
Figure 23. Wireflow: Q&A about a piece

5.1.2 Advertisement (News)

In the news section volunteers share information about their work and how it creates value for the museum; it promotes volunteers' efforts and makes the public aware of it.

Design process

Affinity diagram → Ideation workshop → Collaborative prototyping workshop → *To be continued*

Roles & functions

All volunteers are content creators and can add information in one of the 4 categories (events, theme talks, activities, and museum content). The general public, such as museum visitors, citizens of the museum city or public institutions can visit these categories, read the information and comment on it.

5.1.3 Visitors feedback

Feedback from visitors would be collected through a questionnaire on the platform. The questionnaire includes questions selected by the volunteers and aims to improve their guiding skills.

Design process

Affinity diagram → Ideation workshop → *To be continued*

Visitors fill in a questionnaire shaped by the volunteers on the platform, regarding their visit. Volunteers can later review the answers, adapt their visits to the demands of the public and feel proud of their work.

5.1.4 Claiming volunteers needs

Adding a section in the platform for publicly sharing the present and future needs of the volunteers was ruled out of the design. Volunteers agreed that they wanted to promote their needs by empowering themselves through the news section and to keep communication with public institutions private.

Design process

Affinity diagram → Cultural Probe

5.2 Design with elderly

5.2.1 How might design activities be adapted for elderly participants?

The literature review showed insights to address design activities with the elderly, which were summarized in Appendix A. Recommendations to adapt design activities to the elderly: a review of papers with participatory approach. As well, recommendations were gathered from the activities performed with the elderly.

The elderly suffer from a lack of concentration associated with age as well as they miss social interactions (Demirbilek & Demirkan, 2004; Duque et al., 2019; Elguera Paez & Zapata Del Río, 2019). Therefore, plan unstructured activities with heavy support from the interviewer to keep the activity on track; or structured ones with relative freedom in answers. Don't pressure participants with time and avoid activities that are too long and require focusing or a big memory use. As well, plan design activities in person or with communication channels the elderly already use. Take advantage of the role of a mediator to get the trust of the elderly and test the design activities with a representative of the elderly before carrying them out to be aware of the planning flaws.

Keep in mind participants' technology literacy. Avoid complex terminology or offer explanations about it. To alleviate technology barriers use analogical examples in the activities (*e.g.* a newspaper instead of a blog). However, don't fear introducing easy new technologies as long as they are properly explained and supported by the facilitator. Finally, the elderly need support throughout the activities, which may be for cognitive processes or for manual tasks (such as writing). It's important to be aware of the limitations of the elderly to target the support properly. As well, the elderly feel more comfortable performing activities in safe familiar spaces. Plan activities in places with enough room, materials, and time; don't improvise.

5.2.2 How might user interfaces be adapted for elderly users?

The literature review showed insights to design elderly-friendly interfaces, which were summarized in Appendix B. Recommendations to design elderly-friendly interfaces: papers review. The collaborative Prototyping workshop helped to gather some insights about how the elderly understood interfaces; however, this knowledge is limited to the two participants involved in the activity and would need further study. General recommendations would be to analyze the technology already used by the elderly and the use context. Use the Think-Aloud protocol or similar methods to understand how the elderly navigate the interfaces they are already familiar with. Study where and when the elderly use technology: devices, context, and the intersection of the context and elderly limitations. Finally, it's important to study the terminology the elderly use. Study what terms they use to refer to the concepts that need to be digitalized as well as their problems understanding current interfaces terminology.

5.2.3 How might platforms be adapted for elderly users?

Four categories were identified as influencing the engagement and adoption of platforms by the elderly (Ghosh, 2019). Usefulness has been addressed in several papers to prevent social isolation of the elderly (Bothorel et al., 2011; Koene et al., 2012). Following these guidelines, this project's platform can facilitate intergenerational discussions, introduce new volunteers to the community, and support the ill to connect with their peers. Ease of use and anxiety were addressed in the platforms of Awada et al. (2017), Bothorel et al. (2011), and Shih-Hsun & Wen Huei (2013) by reducing the complexity of the user interface and considering the interfaces with which the elderly are familiar. In the design of the project's platform, the user interface was addressed as a priority with dedicated workshops, and the interfaces of WhatsApp and Google forms were mimicked to support the elderly's knowledge. Finally, the fear of risk was addressed in the platform of Koene et al. (2012) with the creation of a close-knit community for the prevention of fraud. Similarly, the archive of this project's platform was private to make the elderly feel comfortable and not expose their information to non-volunteers.

6 Discussion

6.1 Outcome

The platform design is a mirror of the elderly volunteers' desires. The volunteer who tested the archive section prototyped in *Figma* noted that the choices made throughout the collaboration process were present in the prototype. However, it would need further testing with more users, as the results may be limited. As well, the design of the rest of the sections of the platform should be addressed following the guidelines to plan activities and design interfaces for the elderly.

6.2 Collaboration with the participants

The collaboration with the elderly shaped some of the decisions taken in the project; others happened because of the limitations as a designer (not developer) and because of carrying out the process from Sweden. As well, it was challenging being a facilitator because it was hard to keep the design process moving on, pushing the elderly to take decisions. Sometimes it felt like the choices were not discussed enough with the elderly but the time pressure was pushing the process to move on. As well, the elderly were indecisive about their choices and preferred to just collaborate in the activities rather than participate in the decision-making.

The elderly collaborators thought that the platform would be coded as an outcome of the project, although it was specified the opposite at the beginning of the project. Therefore, their expectations were lowered when they could only see a prototype of it. In future projects, a collaborative session should be offered at the beginning of the project to discuss in depth the outcomes of it.

It was specified in theory the difficulties of working with the elderly that were geographically separated (Duque et al., 2019). Half of the collaborative process of this project was executed from Sweden and half from Spain. Questionnaires, interviews, cultural probes, and user testing were carried out with mediating technology, which has been problematized for the elderly. However, taking into account the technologies known by the elderly and analyzing which methods could be suitable for distance was helpful. Another measurement taken was the creation of the blog, to keep the volunteers updated about the development of the project. However, it didn't have the expected attention, as the elderly didn't check the updates on it or add comments. The blog would still serve as an archive of the mutual learning between the stakeholders and be used for infrastructuring.

The organizational structure played a central role in the project's direction. As stated by de Podestá Gaspar et al. (2018) and Duque et al. (2019) it was important to choose a group of elderly with involvement in a community rather than just bonded by their age. In the project, there was a balance of decisions taken community-wise and elderly-wise. Taking choices just because of their age would rely on poor assumptions when designing for such a heterogeneous group. Therefore, collecting insights about participatory design with the elderly through a project with a community makes results more reliable and trustworthy, as

well as brings benefits like confidence, involvement, and knowledge. The elderly knew each other before the project started so there was trust among them, which led to productive workshops full of discussions.

Finally, state that the recommendations given to shape design activities for the elderly are limited to the participants that collaborated in the project. Therefore, more activities should be planned with a bigger number of participants from different contexts to validate these recommendations. As well, the recommendations are not limited to the elderly, as most of them can be applied to the general public collaborating in a participatory process. They constitute the foundations to plan the design activities but should be adapted to the specific context of the elderly participants. In addition, the engagement and adoption of the platform by volunteers needs to be tested over time to gain insight into how participatory design choices have played a role and how it can be improved.

7 Conclusion

This project aimed to gather insights to adapt participatory design to elderly users, through the involvement of an association of elderly museum volunteers. The purpose was to design a platform to support their work, which included archive, news, and visitor feedback sections. The outcome was the result of a participatory process that involved forms, interviews, cultural probes, and workshops where the volunteers and designer collaborated tightly to explore volunteers' needs and find solutions to address them.

Volunteers wanted to create a platform to empower their work and recognize its value. The participatory methods revealed other needs that could be covered in this design, such as archiving information about the museum pieces, sharing activities organized by the volunteers, and receiving feedback from visitors to improve their work. Each of these needs was shaped into a different platform section and reached a different refinement level throughout the design process due to time constraints.

The recommendations to adapt participatory activities to the elderly were the most valuable outcome. However, they are limited to the volunteers that participated in the project and their context. Therefore, further testing would be needed to validate these insights. On the other hand, the insights to shape interfaces for the elderly were useful. The user testing with one of the volunteers proved to be easy to navigate the archive section of the platform without help, relieving her technology fear. The participatory approach was also used to create an engaging platform that would be easily adopted by older people. However, further testing would be needed as well.

Future work for the project would involve further testing of the insights to adapt design activities, interfaces and platforms to the elderly. This could be addressed by developing further the news and visitors feedback sections of the platform and user testing them. As well, the volunteers desired to have an operating platform they could use, so finding a developers team to code it should be addressed. Finally, a system for learning how to use the platform should be set up by the volunteers. This could take the form of a tech club, as in the QuartiersNETZ project (Sorgalla et al., 2017), or peer support, with volunteers specialising in specific features of the platform.

8 Acknowledgments

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Appendix A. Recommendations to adapt design activities to the elderly: a review of papers with participatory approach

Case study	Methodology & activities involved	Recommendations	Reference
Design of a communication device for elderly users	Participatory design approach. The methods used were interviews, workshops, collages, discussions, workbooks, and photo assignments	Design activities should be carried out in safe spaces for the elderly, so they feel confident to express themselves Design activities that involve social interaction are likely to engage the elderly Design activities with the elderly usually take place double time than with younger participants, because the elderly have more free time to share their life experiences During design activities keep the conversation on track when it's needed, but leave space for freedom	(Sanders & Stappers, 2013)
Design of an ordering food system for elderly users involving direct contact with tags on a device	Participatory design is not specifically mentioned. The methods used were observations, interviews, self-report diary, and free discussion	Use traditional design material (*e.g.* pen and paper) rather than technology mediums for the design activities Take into account the weaknesses of the elderly involved in the activities (*e.g.* some elderly had trembling hands and their handwriting was unreadable) and their fears (*e.g.* when phones were involved in activities the elderly decline them)	(Häikiö et al., 2007)
Support an independent life for the elderly by empowerment through two initiatives: 1.	Participatory design approach. The methods used were neighborhood meetings	Avoid using personas, as the elderly are a heterogeneous group Send invitations to participate in activities through traditional	(Sorgalla et al., 2017)

Joining smart home tech with remote health care; 2. Creating a digital neighborhood platform	(discussions), focus groups, protocols, user stories, sketches, mock-ups, and storyboards	means (post, email, personal invitations from local actors)	
A systematic review of five databases about designing IoT solutions for the elderly	The review includes the PD methods used in each of the cases and it aims to support designers in this context. A summary of the methods is shown in Figure 24.	Diversify the materials (*e.g.* videos, images, pen, and paper) used in design activities to bring more engagement (gamification) Prototyping helps the elderly understand design alternatives Use personas and scenario analysis to represent other stakeholders (*e.g.* caregivers) and to avoid involving the elderly in frightening situations	(de Podestá Gaspar et al., 2018)
Design of doors and door handles for the elderly. These products were designed for the house they wanted to age in	Usability, Safety, Attractiveness Participatory (USAP) Model. The steps of this model are explained in Table 3.	In design activities use traditional materials (pen and paper). Don't expect perfect sketches, but rough ones Record the workshops to analyze the behavioral traits Make the elderly feel familiar with the design process	(Demirbilek & Demirkan, 2004)
A systematic review of papers where UCD/PD processes were carried out involving elderly participants	The methods used were workshops, interviews, focus groups, observations, diaries, and questionnaires. A summary of the methods is shown in Figure 25.	Participatory sessions with the elderly should balance several aspects: the level of technological knowledge, the space where they are developed, the desire for privacy, and communication channels Design activities that involve social interaction are likely to engage elderly Use paper prototyping and "Experience-based PD workshops" to bring trust in technology	(Duque et al., 2019)

Design of a social media and information platform for elderly users	Participatory design approach. Usability, Safety, Attractiveness Participatory (USAP) Model. The methods used were semi-structured interviews, discussions, and testing with Wizard of Oz	Use traditional mediums format for inspiration The elderly prefer face-to-face communication or telephone (need for personal communication) Avoid activities where elderly handwriting is involved, as it can be unreadable Select methods to use with the elderly suitable for their limitations Set a collaborative environment where the elderly can feel part of	(Shih-Hsun & Wen Huei, 2013)

Table 2. Recommendations to adapt design activities to the elderly

Methods for supporting user participation	# of Articles
Workshop	12
Scenarios	11
Brainstorm	2
Design Thinking/Service Design	2
Thinking Aloud	2
Co-construction of Stories	1
Wizard of Oz	1
Brainwriting	1
Design Studio	1
Interactive Posters	1
Day Reconstruction Method (DRM)	1
Several, without detailing	1

Figure 24. Methods employed in each of the case studies of the systematic review of de Podestá Gaspar et al. (2018)

Concept development phase	Concept refinement phase	Prototype construction phase	User trial phase	Production
In the first part the designer is a facilitator and collaborates in a series of activities with the seniors; in the second part the designer	In the first part, the designer presents the sketches and the seniors act on	Designers, ergonomists, and engineers work	The elderly try the prototype and comment	The product is manufactured and introduce

interprets the desires of the seniors and mixes them with his previous knowledge. Methods used: brainstorming, scenario building, and unstructured interviews, with written, oral parts, sketches, and gestures	them; in the second part, the designer makes the final drawings and consults experts. Methods used: sketches	together to produce a prototype.	on it. Methods: dialogue	d to consumer s

Table 3. Phases of the USAP model (Demirbilek & Demirkan, 2004)
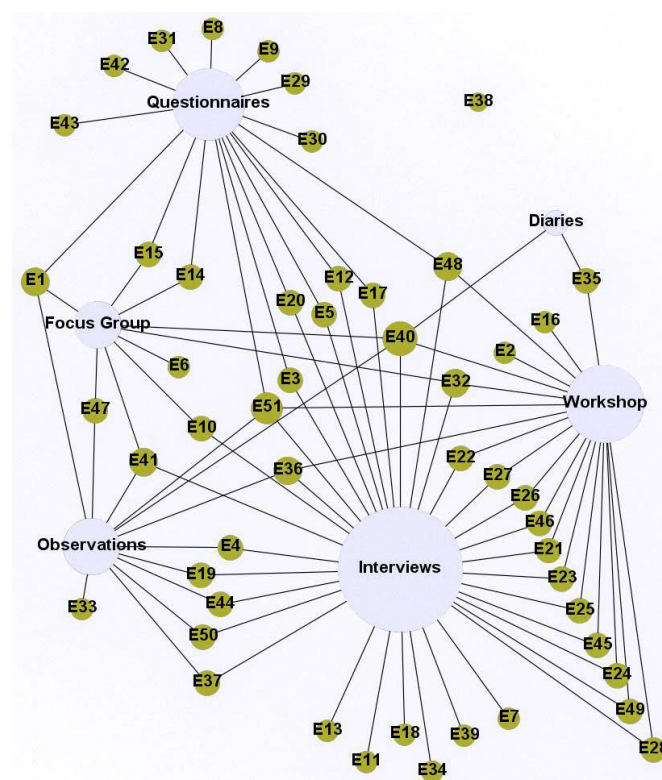
Figure 25. Methods employed in each of the case studies of the systematic review of Duque et al. (2019)

Appendix B. Recommendations to design elderly-friendly interfaces: papers review

Ability impairment	Interface recommendation	Reasoning	Reference
Visual	• Big size for font and icons • Allow font size adjusting • Thick typography • Wide spacing • Balance color contrast (not too strong or low). Allow color contrast adjusting	General visual impairments	(Elguera Paez & Zapata Del Río, 2019)
	• Design easy-to-distinguish buttons • Distribute hyperlinks in bullet points instead of linearly	Confusion when other interface elements look like buttons	(Chou et al., 2013)
	• Pictorial data entry modality	Take less time and is easier to select	(Alsana et al., 2020)
Psychomotor	• Avoid moving text and targets • Reduce the number of interactions (*e.g.* minimize the steps to finish a task) • Avoid challenging actions (*e.g.* drag and drop) • Use icons with labels • Avoid pop-up windows • Create a simple and consistent menu structure • Use traditional pressing buttons	Avoid relying on fine movements, and avoid causing stress	(Chou et al., 2013; Elguera Paez & Zapata Del Río, 2019)
	• Interaction with small elements (*e.g.* touch small buttons)	Difficulties in motor skills accuracy	(Chou et al., 2013; Häikiö et al., 2007)
Cognitive	• Add shortcuts to predefined actions • Avoid long sequences of actions • Simple and flattened menus	Avoid excessive memory load	(Chou et al., 2013; Elguera Paez & Zapata Del Río, 2019; Häikiö et al., 2007)
	• Avoid irrelevant graphics • Avoid ambiguous uncommon terms • Use standard icon design configuration • Provide help (clear instructions)	General cognitive impairments	(Chou et al., 2013; Elguera Paez & Zapata Del Río, 2019)

	• Provide good positioning of the search fields • Avoid drop-down and deep menus • Avoid scroll bars and double-click buttons		
	• Interface elements with different functions need to look significantly different • Create icons that properly represent concepts for the elderly (study of semiotics)	Confusion between the meanings	(de Podestá Gaspar et al., 2018; Elguera Paez & Zapata Del Río, 2019)
	• Avoid long content	Memory recall	(Elguera Paez & Zapata Del Río, 2019)
	• Avoid animations	Hard to focus	(Elguera Paez & Zapata Del Río, 2019)
	• Avoid time constrains	Increase in tension. They take time to check everything carefully	(Chou et al., 2013)
	• Find a lexicon that the elderly understand	The elderly don't relate to the younger generations' terms	(Chou et al., 2013)
Confidence	• Avoid asking for too much personal data	No trust in the internet	(Chou et al., 2013)

Table 4. Elderly-friendly UI design recommendations

Appendix C. Initial questionnaires

Two questionnaires were sent to the volunteers of the association. They were formatted in *Google Forms* and were sent via *WhatsApp* to the volunteers' group. They covered questions regarding two ideas for the project which are explained below and were supposed to take approximately 10 minutes to be filled in each.

The rationale behind this step

Initially, there were two project visions. They were based on the designer's pre-conceived ideas of what designs could benefit the volunteers. At this stage, it wasn't decided what was the project focus and therefore the questionnaires intended to explore different directions.

Suitability for the elderly

At this stage, it wasn't decided how the elderly would connect to the project. The collaboration with the volunteers was established but it was not set the idea of designing something specifically taking elderly needs into account and bringing insights about the process. Studies showed that questionnaires are one of the most used methods in participatory design with elderly participants (Duque et al., 2019); however, the method wasn't shaped in a specific way in this case.

Development of the activity

As described before, there was the need to bring insights and discuss the possibilities of working in two directions with the project. Therefore, two questionnaires were designed. This method had the intention of bringing inspiration as well as understanding what the participants' thoughts were about these topics. The two ideas to discuss were:

- A platform to connect volunteers and visitors. This approach was intended to bring together two types of users. The aim was to connect local volunteers who wanted to explain their experience in the city for free, with visitors who wanted to hear a more personal and experiential vision of this city.
- A tool to connect with visitors. The intention behind this second idea was to create some kind of digital tool with which volunteers could adapt their explanations and knowledge to different types of visitors. This tool was intended to help the most inexperienced volunteers and those with the greatest difficulties in presenting information, with the certainty that the visitor would enjoy the experience.

As mentioned, to obtain greater knowledge about the opinion and acceptance of these ideas, the questionnaires were sent to one of the internal communication channels of the association. The format of the questionnaires is shown in Figure 26 and Figure 27.

Conocimiento en la experiencia

Las preguntas que se plantean a continuación forman parte de un **proyecto de fin de máster** relacionado con el turismo. Se realiza para el Máster en Diseño de Interacción de la Universidad de Malmö. Sus respuestas ayudarán a enmarcar el objetivo del proyecto. ¡Gracias por la colaboración!

El objetivo del proyecto es diseñar una interfaz que permita conectar a dos tipos de usuarios:

- Local: una persona/organización que tiene conocimientos sobre una ciudad basados en su experiencia de vivir en ella, y está dispuesta a compartirlos con otros visitantes
- Visitante: una persona que quiere conocer una ciudad desde la experiencia personal de un local

* Indica que la pregunta es obligatoria

1. **Sobre su experiencia como voluntario en un museo: ¿por qué trabaja como voluntario en un museo?** *

   _____

2. **Sobre su experiencia como voluntario en un museo: ¿qué impacto positivo le aporta la experiencia?** *

   _____

3. ¿Comparte datos o información sobre la vida en su ciudad con otras personas? (personas conocidas o desconocidas) *

   Marca solo un óvalo.

   ◯ Sí
   ◯ No

4. **Referente a la pregunta anterior:** ¿cuál es la razón para hacerlo/no hacerlo? *

   _____

   Escenario B

   Un visitante ha llegado a su ciudad y se pregunta cómo vive la gente en ella. Se pregunta cómo es la vida en los distintos barrios, cómo ha cambiado la ciudad a lo largo de los años, a qué retos se ha enfrentado la ciudad, etc.

5. ¿Le gustaría compartir con estos visitantes información sobre otros asuntos de su ciudad basada en su experiencia de vivir en ella? *

   (por ejemplo, acontecimientos históricos de la ciudad, información sobre otros monumentos, información sobre la vida en los barrios y su identidad, información sobre las tradiciones de la ciudad, etc.)

   _____

6. ¿Cuál es la razón para hacerlo/no hacerlo? *

   _____

7. ¿Qué pedirías a cambio? *

   _____

8. ¿Qué diferencias hay entre los guías turísticos oficiales y los lugareños que comparten sus experiencias sobre la ciudad con los visitantes? *

   _____

Figure 26. Questionnaire I

Experiencia de usuario en el turismo

Las preguntas que se plantean a continuación forman parte de un **proyecto de fin de máster** relacionado con el turismo. Se realiza para el Máster en Diseño de Interacción de la Universidad de Malmö. Sus respuestas ayudarán a enmarcar el objetivo del proyecto. ¡Gracias por la colaboración!

El **objetivo del proyecto** es diseñar una metodología que permita a la industria turística, y en concreto a los guías turísticos, ajustar la información cultural que proporcionan a los visitantes en función de los intereses de estos últimos

* Indica que la pregunta es obligatoria

1. ¿Cuáles de estos elementos tiene en cuenta a la hora de dar información a los visitantes? *

   Selecciona todos los que correspondan.

   ☐ Tiempo disponible del visitante
   ☐ Ritmo (si los visitantes pueden seguir un ritmo rápido mientras visitan los lugares o no)
   ☐ Idioma
   ☐ Compromiso (si cambia el guión en función del interés de los visitantes durante la visita)
   ☐ Edad del visitante
   ☐ Intereses (por ejemplo, arquitectura, naturaleza, arte, gastronomía)
   ☐ Accesibilidad (si el visitante puede llegar al lugar)
   ☐ Ninguno
   ☐ Otro: _____

2. ¿Los visitantes le dan su opinión sobre la calidad de la información que les ha proporcionado? *

   Marca solo un óvalo.

   ◯ Sí
   ◯ No

3. **Referente a la pregunta anterior**: en caso afirmativo, ¿cuáles * son las principales preocupaciones de los visitantes y qué hace usted con ellas? ¿Cuándo recibe esos comentarios?

   En caso negativo, ¿por qué no recibe esos comentarios?

   _____
   _____
   _____
   _____

   Escenario A

   Una familia con niños quiere información sobre qué ver en su ciudad. Les interesa la naturaleza y los museos, pero no pueden seguir un ritmo de visitas rápido porque llevan un carrito

4. ¿En qué medida influye el tipo de información que les das según * estos condicionantes?

   _____

5. ¿Daría la misma información a un visitante con un perfil diferente? *

   _____

6. ¿Qué dificultades plantea adaptar la información a los distintos * visitantes?

   _____

Figure 27. Questionnaire II

Results and insights for elderly suitability

The questionnaires' answers were analyzed and insights were brought up. As stated before, the purpose of the activity was to get inspiration and learn what the volunteers were interested in. The conclusions about the platform to connect volunteers and visitors were the following:

- The reasons for sharing cultural information would be pride, the importance of its heritage, bringing more visitors, and enriching themselves with varied opinions and experiences.
- Volunteers have a great passion and knowledge based on experience, many times with stories that people do not know.
- In exchange for a free explanation, they would only ask for attention and respect.

The conclusions about the tool to connect with visitors were the following:

- Volunteers generally take into account the experience of visitors, especially their interests and time. Some find it difficult to be versatile in adapting the information.
- Visitors' feedback is received during and at the end of the visit.

There are no insights about how to shape this method for the elderly, as it was not the rationale behind using it. However, based on the answers received, some recommendations are proposed. These recommendations are limited to the number of volunteers that answered and are based on assumptions, so further analysis would be needed.

- Typing issues. Some elderly experience difficulties when typing on small keyboards, as proposed by Demirbilek & Demirkan (2004) and Elguera Paez & Zapata Del Río (2019). Most of the answers received probably were filled on smartphones; therefore, finding the correct keys could be an issue. Vision problems could have enhanced this issue (Elguera Paez & Zapata Del Río, 2019). This situation can be seen in some answers with spelling mistakes.
- Format issues. Some elderly experience difficulties using online questionnaires format. This format can be novel to some of them and can involve confusion. This situation can be seen in some answers that are left halfway written or when multiple questions are asked, it is found complex to answer all of them in the text input interface. This indicates that it should be avoided to ask several questions and just leave one space to reply. As well it's important to be aware of the technical knowledge of each of the participants to shape the design activities for a specific group and don't cause comprehension difficulties (Duque et al., 2019).

Appendix D. Cultural probe I

A cultural probe was sent to one volunteer to gain insights about the daily problems faced in their volunteering. It was carried out with the help of *WhatsApp* and during the time of one morning. It involved simple instructions to perform in their work context.

The rationale behind this step

To gain more insights into the experience of the volunteers, one last activity was performed in the discover phase of the project. This cultural probe is intended to bring insights into the problems of the volunteers in the context of the museum through reflecting while working.

Suitability for elderly

Cultural probes are useful methods for designers to get inspiration from the experiences of the participants. They consist of a series of materials facilitated to participants to be creative and share insights about their context (Koefoed Hansen & Kozel, 2007; Martin & Hanington, 2012). They fit for the elderly as a design activity because they can carry them out at their own pace, without the pressure of answering questions at the moment and recalling to memory (Elguera Paez & Zapata Del Río, 2019; Sanders & Stappers, 2013).

However, it was a problem creating design material from Sweden and bringing it to the participants, as well as receiving it back. It was decided that a mediating technology should be introduced to ease the task. This could be a challenge for the elderly that are in a geographically separated context (Duque et al., 2019). Therefore, this issue was alleviated by using technology the elderly were already familiar with and able to use: *WhatsApp. WhatsApp* offered infinite possibilities to gather information from their context and send it to the designer instantly. As well, it avoided dealing with the handwriting of elderly participants. Although some sources suggest using pen and paper to carry out the activity, some state that the elderly could have shaky hands and unreadable writing (Häikiö et al., 2007). Another option considered to solve the geographical separation was sending to the elderly a list of instructions to perform and materials to acquire in Spain, and later photograph them and send them back. However, this could suppose an inconvenience and a greater technological challenge for them.

Development of the activity

The volunteer received the instruction through a phone call. The instructions consisted of documenting with notes, pictures, or drawings any problem that she found in the museum while working there. This information needed to be sent through *WhatsApp* along the time extension of one morning. The intention was to gather insights about their work experiences from their perspective and serve as inspiration for the design process (Martin & Hanington, 2012).

Results and insights for elderly suitability

Since the cultural probe was conducted after the interviews, the problems that worried the volunteer had already been documented. The attention in this activity landed on the

outdated communication format of the museum (signage not available in different languages and too long texts), rather than problems related to the volunteers' work. Therefore, the outcome of the activity didn't impact the design process but served to gain the confidence of the volunteers.

Recommendations to carry out design activities with the elderly, based on this cultural probe, are proposed:

- Already known technology**.** It was regarded useful for the volunteer the convenience of using the communication channel she was familiar with. She said it was easy to send pictures and text information in real time.
- Guidance. It is important in a cultural probe to clearly explain the instructions of what the participants need to do. In this cultural probe, the instructions offered too much freedom and the results were not the expected. Therefore, it's needed to be more concise. This is a general recommendation, not only related to the elderly participants.

Appendix E. Cultural probe II

Taller: exponer las necesidades de los voluntarios

En primer lugar, gracias por participar en el proyecto! Si tienes alguna duda sobre lo que se explica en este cuestionario, puedes contactarme por WhatsApp sin ningún problema :)

Después de investigar las diferentes oportunidades que había en la asociación para introducir un diseño que apoyase a los voluntarios, me llamó la atención los problemas de comunicación que existían con el Patronato de la Alhambra. De acuerdo a varios voluntarios entrevistados, anteriormente se tenía derecho a acceder al recinto de la Alhambra en cualquier momento, así como a aparcar el vehículo personal en el parking gratuitamente. En cuanto a lo primero dicho, acceder a los palacios servía como fuente de información para las explicaciones de los voluntarios, por lo que se consideraba como un derecho básico para realizar correctamente las explicaciones. En cuanto a lo segundo dicho, algunos voluntarios acuden desde muy lejos en coche y tienen la necesidad de aparcar cerca del Museo, ventaja que han perdido.

Según los entrevistados se ha intentado contactar con el Patronato a través del correo electrónico en numerosas ocasiones sin recibir respuesta. Por tanto, una oportunidad para la página web de los voluntarios podría ser la de dar visibilidad de las necesidades de esta asociación: relatar vuestras experiencias y dar a conocer a la ciudadanía cómo podría facilitarse vuestra labor.

* Indica que la pregunta es obligatoria

1.
¿Ves importante visibilizar públicamente las necesidades de los voluntarios? ¿Por qué?   *

2. ¿Funciona sin complicaciones la comunicación con el Patronato? ¿Por qué?

_____
_____
_____
_____
_____

Un ejemplo: Change.org

En la actualidad encontramos diferentes páginas web para dar visibilidad a las necesidades de diferentes individuos y asociaciones. Una de ellas en Change.org. En esta página se exponen peticiones de personas/asociaciones con el objetivo de recaudar firmas y conseguir apoyo para las causas que promocionan. Cada petición consta de: 1. Una sección donde se expone el problema que hay, 2. Una sección donde se añaden razones para apoyarla y por último 3. Una sección donde se incluye un formulario para firmarla. Un ejemplo de estas peticiones sería la que se expone en las imágenes, para salvar el Museo Barroco de Puebla.

He añadido esta referencia a la página web Change.org por daros un ejemplo de cómo exponer necesidades en un formato digital. No tiene nada que ver con el formato que podría tomar en vuestra página web de voluntarios, sino que sirve para haceros pensar sobre qué funciones podría tener y si es algo que veis importante.

3. ¿Cómo querrías dar visibilidad a las necesidades de la asociación?   *

_____
_____
_____
_____
_____

4. ¿Crees que un formato digital (en la página web) podría ser una solución?

_____
_____
_____
_____
_____
_____

5. ¿Qué información querrías que tuviera tu petición? (por ejemplo: * el motivo, en qué os afecta, a quién involucra, etc.)

Figure 28. Form for the Cultural probe