Engaging Older Adults in Participatory and Intergenerational Design Teams and Processes: a Systematic Review of the Current Investigation

Ana Carla AMARO, PhD
University of Aveiro, DigiMedia
PORTUGAL
aamaro@ua.pt

Rui RODRIGUES, PhD
Miguel Torga Institute of Higher Education, DigiMedia
PORTUGAL
ruirodrigues@ismt.pt

Lídia OLIVEIRA, PhD
University of Aveiro, DigiMedia
PORTUGAL
lidia@ua.pt

Abstract: This paper presents the results of a systematic review of the literature (SRL) in the field of Participatory Design (PD), undertaken under the scope of LOCUS – Playful Connected Rural Territories. The project employs an ethnographically, participatory and agile approach to the process of co-designing, developing and evaluating an IoT system to support playful intergenerational engagement in exploring cultural heritage of Portuguese rural territories, by engaging inhabitants, stakeholders and visitors. The SRL aimed to understand how older adults have been integrated and engaged into technology PD teams and processes. This paper focus on the most used methodological approaches and participation methods, along with the challenges in integrating older adults and the strategies to overcome them, which are discussed in the light of project aims.

Keywords: older adults, participatory design, intergenerational, ICT, systematic review

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Engager les personnes âgées dans les équipes intergénérationnels et processus de design participatif: une revue systématique de la recherche actuelle

Résumé : Cet article présente les résultats d'une revue systématique de la littérature dans le domaine du design participatif, effectuée dans le cadre du Projet LOCUS - Territoires ruraux connectés et ludiques. Le projet utilise une approche ethnographique, participative et agile du processus de co-design, développement et évaluation d'un système d'Internet des objets pour soutenir un engagement intergénérationnel ludique dans l'exploration du patrimoine culturel des territoires ruraux portugais, en impliquant les habitants, les parties prenantes et les visiteurs. La revue systématique de la littérature vise à comprendre comment les personnes âgées ont été intégrées et engagées dans des équipes et des processus de design participatif des technologiques. Cet article se concentre sur les approches méthodologiques et les méthodes de participation les plus utilisées, ainsi que sur les défis de l'intégration des personnes âgées et les stratégies pour les surmonter, qui sont discutés à la lumière des objectifs du projet.

Mots-clés : personnes âgées, design participatif, intergénérationnelle, TIC, revue systématique de la littérature

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Introduction

This Systematic Review of the Literature (SRL) (Liberati et al., 2009; Moher et al., 2009), was undertaken under the scope of the LOCUS Project[1]. LOCUS is a multidisciplinary project aiming to co-design, develop and evaluate an Internet of Things (IoT) system and understand its potential to support playful intergenerational engagement in exploring the cultural heritage (CH) of rural territories from the Centre Region of Portugal, namely *Amiais* Village, in *Sever do Vouga*.

LOCUS will deliver an IoT system, which will enable immersive gamified experiences, collaboratively learn about CH and produce and share multimedia georeferenced contents. Points of interest and objects around the village will be digitally tagged and augmented according to playful CH scenarios and narratives. Visitors will be able to interact with the objects by using their smartphones and a bracelet with embedded readers and sensors, which will identify the objects and how they are handled. System will respond accordingly, by playing sounds, showing augmented reality, requesting the upload or sharing of multimedia content, the search for a new object, and so on.

[1] LOCUS is co-funded by FCT - Foundation for Science and Technology, through National Funds (PTDC/COM-CSS/29228/2017), and by the European Regional Development Fund, framed in the Operational Programme for Competitiveness and Internationalisation - COMPETE 2020, under the new partnership agreement PT2020 (POCI-01-0145-FEDER-029228). For more information, please see https://locusproject.pt.

As such, LOCUS will employ an ethnographically, participatory and agile approach to the process of co-designing, developing and evaluating the IoT system, being those methodologies of paramount importance to achieve the project goals. Considering this, and within the scope of LOCUS' Literature Review phase, different SRL were carried out. This paper particularly refers to an SRL in the field of Participatory Design (PD), namely on the integration and engagement of seniors in participatory and intergenerational teams and processes of technology design, aiming to answer the following question: How older adults have been integrated and engaged into technology participatory design teams and processes?

According to Simonsen & Robertson (2013), PD is about the direct involvement of people in the co-design of ICT they use and how design processes can be adjusted to embrace that involvement, namely by considering the need to adapt the overly abstract representations of traditional design and development tools and processes, in order to facilitate participation.

The fact that the project takes place in a markedly rural area with a very old population and low levels of ICT skills poses additional challenges to the inhabitants' involvement in PD teams and processes. In this way, and in order to assemble the best strategies to facilitate and promote this involvement, seems crucial to carry out an exhaustive survey of how older adults have been integrated into participatory and intergenerational design teams and processes.

In this way, the next section covers an overview of PD and the involvement of older people in the co-design of technology-based projects. The subsequent sections will focus on the most used methodological approaches, the barriers to integrating older adults in PD teams and processes and in the strategies and methods used to ensure participation and engagement.

1. Background

The PD concept has been evolving since its appearance in the 70's with some Scandinavian projects (Simonsen & Robertson, 2013). The focal point in PD research become the development of design processes which consider that participation must be negotiated and equalized as an integral part of democratic practices to engage people, working with and learning from them in actual settings and thus giving rise to engaging PD tools, techniques and conceptual frameworks (Bannon et al., 2019; Kensing & Greenbaum, 2013; Loos et al., 2019; Schiau et al., 2018). Thus, PD is an approach to the creation and design of tools. When applied to the development of technology, they are processes that allow to go, in a closer way, to meet the real needs of the user, since they are carried out with their active intervention and collaboration. PD is about the direct involvement of people in the co-design of ICT they use and how design processes can be adjusted to embrace that involvement, namely by using design-by-doing techniques (Simonsen & Robertson, 2013).

In this context, technology-based projects are found in many research centres that include the participation of people and, for this reason, have an impact on these and on the territory where they are implemented, as are the cases of projects with the purpose of contribute to the maintenance and sustainability of CH, similar to LOCUS (Andrade & Dias, 2020; Pereira & Martins, 2018; Petrelli, 2019), or projects that have other scientific interests and/or come from other areas (Cozza et al., 2016; Gomes et al., 2018; Östlund et al., 2020; Tessarolo et al., 2019). In addition to these projects, there are also other projects that underlie the integration of PD, as well as other techniques also applied in the LOCUS Project (e.g., ethnographic study and workshops with residents) and what is their impact on the final results, including the involvement of the older people in participatory and intergenerational design teams and processes.

Since the approach to the application of PD in ICT projects can vary in depth, from the application of small sessions (e.g., Focus Group) to the inclusion of practices of PD in all stages of the project, it is important to understand how this participation can be useful and enriching to these projects, either at a specific context, or during the entire development (Whittle, 2014). In this context, the involvement of users in the entire design process is even more relevant when it involves the older adults, especially in ICT projects. For many years, the inclusion of the older adults was not considered relevant because they were, supposedly, resistant to the use of technology, or not trusted their ICT-related skills (Cozza et al., 2016; Kopec et al., 2018; Lindsay et al., 2012). However, the inclusion of older adults in technological studies has raised, thanks to the result of the increasing people's life expectancy, and the importance that this kind of projects can have in older adults' health and well-being.

Therefore, the engagement of older adults in PD teams and processes can be very useful. Several studies have shown that the older adults seems motivated to be able to contribute with their own life experiences, feeling more motivated and engaged in contributing to the project in which they are included, as well as knowing that these technologies can be useful for them (Kopeć, Nielek, et al., 2018; Lindsay et al., 2012). At the same time, older adults are a group that feels some apprehension of participating in tasks of a technological nature. However, this effect "*can be mitigated by positive social intergenerational contact and the feeling of working for a greater good*." (Kopeć, Nielek, et al., 2018, p. 51). Therefore, it is essential to create a co-design approach adapted to older adults, where the focus should not only be the use of technology but also provide intergenerational involvement and social inclusion. In that way, the older people feel integrated in the team and in the whole design process.

2. Method

2.1. *Research question and goals*

This SRL intends to answer the following question: How older adults have been integrated and engaged into technology participatory design teams and processes?

As such, the SRL has the following goals:

i) To identify the most used methodologic approaches and methods to integrate older adults in intergenerational teams for the PD of technology;

ii) To understand in what stages of the development processes older adults are involved in and why;

iii) To describe the characteristics of participatory design teams which involve older adults;

iv) To understand the challenges that researchers face when involving older adults in PD teams and processes and which strategies are best suited to overcome those challenges, by promoting effective engagement.

This paper will only focus on the fulfilment of goals i) and iv).

2.2. *Search strategies and procedures*

The search was undertaken in Scopus and Web of Science, using the queries in Table 1.The queries were applied between June 27th and July 17th, 2019. Beside the identified databases, other sources were used, namely researchers' private collections of papers and the bibliographic references of the selected papers. The authors privileged the use of complete words, avoiding acronyms as much as possible, exceptions were ICT and IoT.

2.3. *Inclusion and exclusion criteria*

The documents selected for the SRL cumulatively met the following inclusion criteria:

– Have been published between 2010 and 2019;

– Fall within the specific thematic scope of this SRL;

– Present sufficient information on a sound methodological approach to the integration of older adults into intergenerational teams and processes of technology (software or hardware) participatory design;

– Consider older adults as being people aged 60 years old or more.

Table 1. Queries used in the different databases

Database	Query
Scopus https://www.scopus.com	(TITLE-ABS-KEY ("Collaborative design") OR TITLE-ABS-KEY ("participatory design") OR TITLE-ABS-KEY ("participative design") OR TITLE-ABS-KEY (co-design) OR TITLE-ABS-KEY (co-production) AND TITLE-ABS-KEY ("older adults") OR TITLE-ABS-KEY (elders) OR TITLE-ABS-KEY (elderly) OR TITLE-ABS-KEY (intergenerational) AND TITLE-ABS-KEY (ict) OR TITLE-ABS-KEY ("Information and communication technology") OR TITLE-ABS-KEY (iot) OR TITLE-ABS-KEY ("internet of things") AND PUBYEAR > 2010)
Web of Science http://webofknowledge.com	ALL=(("collaborative design" OR "participatory design" OR "participative design" OR co-design OR co-production) AND ("older adults" OR elders OR elderly OR intergenerational) AND (ict OR "Information and communication technology" OR "internet of things" OR IoT) Timespan: 2010-2019

Were excluded from the SRL all the documents that did not meet the inclusion criteria. In addition, documents reporting studies whose participants had any mental health condition were excluded. Were also excluded documents which researchers were unable to access, not written in English and duplicate.

The inclusion and exclusion criteria were applied by two researchers, based on the reading of the titles and abstracts of the papers. Only when the titles and abstracts did not allow an unambiguous evaluation, the papers were fully read. In cases of doubt, the opinion of a third investigator was requested.

2.4. *The corpus of analysis*

The search in Scopus and Web of Science yielded a total of 45 and 22 potentially eligible documents, respectively. Applying the inclusion and exclusion criteria to this set of 67 documents[2] led to the exclusion of a total of 52 documents (cf. Table 2).

In this way, this process yielded 15 eligible documents, to which researchers added five more from their private paper collections, and six more from the

[2] The document with the selection process is available at https://tinyurl.com/y8r8yv9c.

bibliographic references of the selected papers, totalling 26 documents, which constituted the corpus of the analysis[3] (cf. Table 2).

Table 2. Number of documents excluded by exclusion criteria

Exclusion criteria	Nº of docs
Does not fall within the specific thematic scope of the SRL	20
Duplicated document	13
Does not present sufficient information on a sound methodological approach	8
Participants had mental health conditions	6
Without access	3
Not written in English	1
Not published between 2010 & 2019	1

2.5. *Data Extraction and Analysis*

Once selected, papers were fully read. Documents were coded and analysed considering how older adults were integrated and engaged into intergenerational teams for technology (software or hardware) co-design and how their effective participation was ensured, according to a set of main categories. For the purpose of this paper, the main categories considered are Methodological approaches, Challenges in integrating older adults, Strategies to promote participation and engagement, and Participation methods.

Data was extracted and organized into tables on Google Sheets, prepared to compile the information related to the main categories of the analysis. Data extraction was carried out by two researchers. Thus, the use of shared spreadsheets made it easier for the researchers to collaborate, also facilitating the management and processing of the data.

3. Results

3.1. *Methodological approaches*

As shown in Table 3 all the analysed studies (N=26) identify PD or Co-design as the broader methodological framework for involving older adults in the design and development of technology. These studies anchor in central PD values, such as participation, cooperation and situatedness (Ferati et al., 2018), and fundamental PD assumptions, identifying users as experts of their own experience (Giorgi et al., 2013), and able to make creative design contributions, when the proper tools are given to them (Alaoui et al., 2014; Mincolelli et al., 2019).

[3] The document with the corpus of the analysis is available at https://tinyurl.com/y9jy5yo5.

Table 3. Total studies coded (N) and total studies uniquely coded (UC) by methodological approach

Methodological Approach	**Studies**	**Nº of Studies *(N)***
Participatory Design/ Co-design	(Alaoui et al., 2014);(Balcerzak et al., 2017);(Bergvall-Kåreborn et al., 2010); (Biocca et al., 2017); (Duh et al., 2016); (Ferati et al., 2018); (Giorgi et al., 2013);(Haak et al., 2015); (Hepburn, 2018); (Hornung et al., 2017); (Jelen et al., 2019); (Kopeć, Balcerzak, et al., 2018); (Kopeć, Nielek, et al., 2018); (Lindsay et al., 2012); (Mincolelli et al., 2019); (Müller et al., 2015);(Orso et al., 2015);(Pedell et al., 2017); (Raju, 2018); (Rice & Carmichael, 2013) ; (Rogers et al., 2014);(Sengpiel et al., 2019); (Sorgalla et al., 2017); (Vines et al., 2012); (Volkmann et al., 2019); (Widyanuri & Octavia, 2015)	*N=26 (UC=16)*
Living Lab	(Alaoui et al., 2014); (Bergvall-Kåreborn et al., 2010); (Müller et al., 2015); (Pedell et al., 2017)	*N=4 (UC=0)*
HCD (Human-Centred Design)	(Bergvall-Kåreborn et al., 2010); (Mincolelli et al., 2019)	*N=2 (UC=0)*
HCD+ (Human-Centred Design for Aging)	(Sengpiel et al., 2019); (Volkmann et al., 2019)	*N=2 (UC=0)*
SPIRAL (Support for Participant Involvement in Rapid and Agile software development Labs)	(Kopec et al., 2018)	*N=1 (UC=0)*
OASIS (Open architecture for Accessible Services Integration and Standardization)	(Lindsay et al., 2012)	*N=1 (UC=0)*
Emotional-Led Design	(Pedell et al., 2017)	*N=1 (UC=0)*
Research Circle Methodology	(Haak et al., 2015)	*N=1 (UC=0)*
FormIT	(Bergvall-Kåreborn et al., 2010)	*N=1 (UC=0)*

Within this broader methodological positioning, the main focus is a "*change in attitude from design for users to design with users*" (Alaoui et al., 2014, p. 381), and as far as older adults are concerned, "*bring power to the voice of those often excluded from design while tapping into the wisdom and 'domain' knowledge of retired people through including them as [full] participants in design conversations and activities*" (Rogers et al., 2014, p. 3915).

Nevertheless, 10 of these studies also identify, within this general PD framework, more specific methodologies, such as Living Lab (*N=4*), HCD (Human-Centred Design) (*N=2*), HCD+ (Human-Centred Design for Aging) (*N=2*), SPIRAL (Support for Participant Involvement in Rapid and Agile software development Labs) (*N=1*), OASIS (Open architecture for Accessible Services Integration and Standardization) (*N=1*), Emotional-Led Design (*N=1*), Research Circle Methodology (*N=1*), and FormIT (*N=1*).

Living labs emphasize the importance of real-life contexts to understand the users' needs, while providing a frame for collaboration between stakeholders and users, who participate as informants, testers, contributors, and co-creators, to conceive and develop holistic, sustainable and innovative tech-based platforms, products and/or services (Müller et al., 2015; Pedell et al., 2017). This kind of methodology is particularly (but obviously not exclusively) used in the health-care domain.

Human-Centred Design (HCD), is a wide methodologic umbrella in which fit the approaches "*focusing on the users, their needs and requirements, and by applying human factors/ergonomics, and usability knowledge and techniques"*(International Organization for Standardization, 2019). As such, by definition, HCD does not imply active involvement of users in technology design and development teams and processes. In fact, both studies positioned under this umbrella, refer other complementary methodological approaches, namely Participatory Design (Bergvall-Kåreborn et al., 2010; Mincolelli et al., 2019), Living Lab and FormIT (Bergvall-Kåreborn et al., 2010).

Volkmann, T., et al. (2019) and Sengpiel, M., et al. (2019) bring together the PD approach and an HCD approach which takes older adults especially into account, called HCD+ (Human Centred Design for Aging). Hence, the method determines the involvement of older adults' as participatory designers, providing special guidelines for recruitment, the working environment with older adults and for adapting techniques and instruments.

Kopeć, W., et al. (2018) and Lindsay, et al.. (2012) also propose and adopt methodologies special adapted for older adults, respectively SPIRAL (Support for Participant Involvement in Rapid and Agile software development Labs) and OASIS (Open architecture for Accessible Services Integration and Standardization).

SPIRAL draws on the research about barriers and challenges, and on the best PD practices to propose a 4-step model, consisting of "*lowering technology barrier by*

increasing ICT skills; enabling direct involvement with technology in everyday context and a positive emotional experience; exposing participants to intergenerational interaction: facing stereotypes with contact theory; empowering older participants by providing introductory step-by-step and hands-on experience trainings" (Kopeć et al., 2017, pp. 52–53). OASIS (cf. Figure 1), on its turn, consists of four stages: identification and recruitment of stakeholders, creation of gapped video materials for the idea generation stage, exploratory group meetings and low fidelity prototyping (Lindsay et al., 2012).

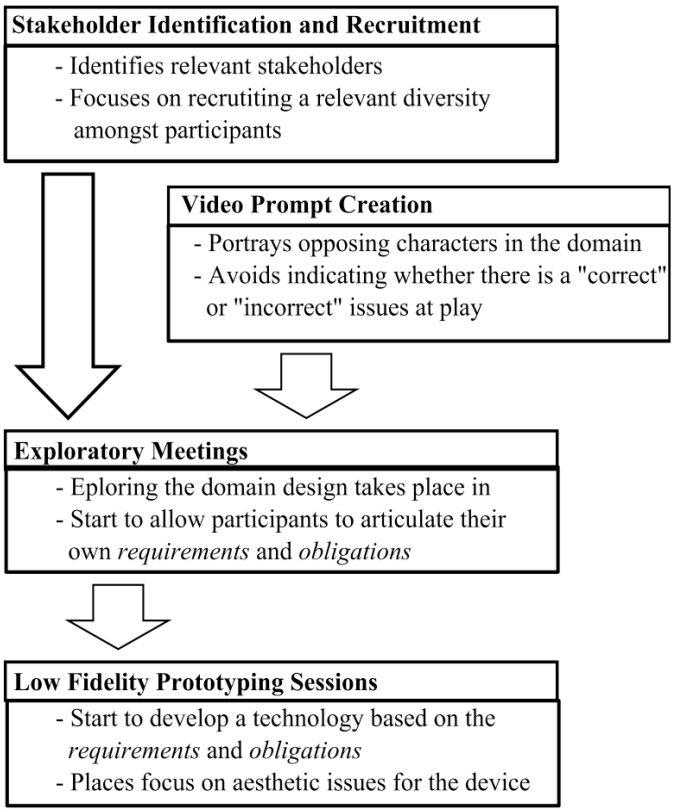


Figure 1. *The OASIS process (image source Lindsay, et al., 2012, p. 1203)*

Within the scope of a Living Lab project and as a complement to functional-driven design, Pedell, et al. (2017, p. 7) apply an emotional-led design methodology, which aim giving "*older adults a strong voice to share and describe their experiences and emotions and to explore how these insights can be captured for design purposes*". The method is a kind of toolkit, including motivational goal

models, animations, and technology probes, that can be used at different phases of a living lab project to promote communication between participants.

Bergvall-Kåreborn, et al. (2010) also use a methodology to support a Living Lab project - FormIT -, which is a holistic approach to the understanding of people's needs, emphasizing equity, autonomy, and control as far as real use situations are concerned. Although a three-cycled method - concept design, prototype design, and final system design -, FormIT stresses out the basic importance of the first phase, as the stage in which users contribute more deeply. Furthermore, the method is based on iteration between participants with diverse knowledge and skills, as facilitator of creativity and innovation.

By adapting well-established methodologies and approaches or by developing entirely new approaches, most of the analysed studies considered and/or faced difficulties, barriers or challenges related to the involvement and engagement of older adults in PD teams, as described in the next section.

3.2. *Challenges in integrating older adults and strategies to overcoming them*

Though older adults are a "very heterogeneous group, especially regarding technology experience and adoption" (Sengpiel et al., 2019, p. 11; Stone et al., 2017), researchers generally describe older adults as non-tech-savvy people, reporting challenges related the lack of ICT skills, such as inexistent knowledge about modern technology, difficulties in understanding basic ICT concepts and the impact that technologies can have on their lives, and also in articulating their needs in respect to technology (Kopeć, Nielek, et al., 2018; Müller et al., 2015; Pedell et al., 2017). Hence, older adults' inputs into the design process can be limited by these issues.

Another reported challenge, that in part relates with the previous one, concern older adults' difficulties envisioning new technologies and/or engaging in creative thinking around abstract and intangible issues (Duh et al., 2016; Lindsay et al., 2012; Rogers et al., 2014). As such, older adults can struggle with concept design activities, involving for example narratives and scenarios, that require them to imagine how a prototype might look like or behave (Orso et al., 2015).

Researchers often find difficult to keep older adults focused on tasks or discussions topics during design sessions, especially in long sessions involving deep exploration of issues, management of dense information or attention to materials or speeches (Duh et al., 2016; Lindsay et al., 2012; Orso et al., 2015). As Orso et al. (2015) points out, these tasks can be excessively demanding for older adults, due to the decline of working memory, the ability to inhibit irrelevant information, and the ability to pay attention to peripheral stimuli in the visual field.

Kopeć, Nielek, et al. (2018) mention two other problems that may impact older adults engagement in PD teams and processes, namely older adults' lack of self-confidence and limited social involvement, that often fuels a feeling of alienation

from the highly digital society, and low criticism levels, making them eager to accept the solutions proposed by others with low questioning.

Besides, as Orso et al. (2015, p. 102) points out, methods, techniques and instruments used to engage older adults as co-designers, also need adaptation to the cognitive and physical changes that aging naturally brings.

Problems and barriers, however, are not always on the side of older adults. Ageism brings age-related stereotypes among technology designers and developers concerning older adults' activities, interests, and mental capacities, being a significant contributor to neglecting their experiences, needs, and desires and hence integrate them in PD design teams and processes (Kopeć, Nielek, et al., 2018; Lindsay et al., 2012).

As far as strategies to overcome all these challenges are considered, addressing ageism problem seems a priority. Research demonstrate that older people do not conform to ageist stereotypes that many technology designers and developers hold (Lindsay et al., 2012). Users, regardless of age, have particularities which must be considered and respected. Hence, reported strategies revolve around the need to sensitize designers more to this reality, namely by promoting intergenerational interaction.

Rogers, et.al. (2014, p. 3915) suggests that "*pairing design students with older people can open their eyes to seeing the world of aging differently*". Kopeć, Nielek, et al. (2018), on their turn, included an entire step in the SPIRAL method dedicated to intergenerational interaction. In this step, which grounds on contact theory, a miniature of the whole design process is put into action, by involving different age people in hackathon teams. According to the authors, "*the intention of this step is to provide an opportunity for immersion of older adults in the development process and facing stereotypes from both sides of the process*." (Kopeć, Nielek, et al., 2018, p. 54).

Bringing this intergenerational interaction to less formal and structured situations of cake, coffee, and talk type is the strategy proposed by Hornung et al. (2017) and Müller et al. (2015): "*we brought cake and made coffee, sat together with the participants and talked to them about their problems, fears and wishes in order to learn more about their everyday lives*."(Hornung et al., 2017, p. 7060). These sessions intended not only to sensitize the team for each one's interests, needs, and limitations but also to develop trust and promote the active engagement of older adults in the PD process.

Some of the strategies to address the lack of ICT skills found in the analysed studies concern teaching older adults about technology, in more or less formal ways. The SPIRAL method, for example, comprises a step devoted to lowering the technology barrier, by using some formal educational techniques, such as traditional computer courses and workshops, and by introducing basic ICT notions and tools, like email or social media (Kopeć, Nielek, et al., 2018). Raju (2018) also describes a

set of educational sessions intended to teach older adults how to use tablets and shopping apps. In Orso et al. (2015), older adults were instructed on the characteristics of the application to evaluate via practical tutorials with an expert.

In a much less formal format, Hornung et. al. (2017) and Müller et al. (2015) slowly introduced into the cake, coffee, and talk meetings mobile devices and apps, such as interactive maps, email, instant messaging and web browsing, which could support older adults in their daily lives.

These strategies, though, can raise problems in handling expectations of people with different ICT skills, as more tech-savvy participants may become bored by repeating basic topics, as was the case in the study by Müller et al. (2015).

Being cost-effective, quick, requiring no technical skills and, at the same time, helping older adults envisioning future technologies and overcoming the abstract and intangible nature of some technical and design issues, the use of low-tech and paper-based artifacts and prototypes are proposed as engaging strategies by Bergvall-Kåreborn et al. (2010), Ferati et al. (2018) Jelen et al. (2019), Lindsay et al. (2012), Orso et al. (2015), Pedell et al., (2017), Rice & Carmichael (2013) and Rogers et al. (2014). These strategies can materialize in different instruments, such as physical models, life-sized paper-based mock-ups, storyboards for animated scenarios, paper-based prototypes, illustrated cards, among others

Cartographic mapping is one of these paper-based strategies to gain insight about people's everyday lives: "*by using only materials familiar to all, such as images, paper, post-it notes, and pencils, participants are encouraged to start telling their stories and to visualize their experiences and wishes*" (Ferati et al., 2018, pp. 248–250). In Rice & Carmichael (2013), cardboard and transparent cut-outs of various graphical components were used by participants to assemble personalized interface layouts.

In an earlier stage of the PD process, the same researchers used a different low-tech approach, based in real-life examples: interactive theatre. Short and open-ended scenarios and characters enacted ways in which users might behave in the context of novel applications, thus helping older adults to envision possibilities and generate new initial ideas. Real-life based examples for involving older adults in prototyping activities are also reported by Volkman et al. (2019), who used a simulation game. In this type of game, participants play specific roles, related to the design domain.

The use of mid-tech or high-tech exemplars, examples, or visual prompts is another approach to supporting older adults' creative thinking by materializing abstract aspects. In Jelen et al. (2019, p. 4), two exemplars were created to allow older adults to get involved in creating customized electronic devices "*by providing ideas for how Craftec could be used, which they can modify rather than starting from scratch*."

Orso et al. (2015) used a similar strategy, showing participants a sample video clip resembling the possible outcome of the tasks researchers want them to perform

to create contents for the SeniorChannel. The OASIS methodology also employs a video prompting strategy, by presenting older adults a video depicting intangible issues, which can be used as a starting point for discussions concerning the abstract aspects that relate to the design domain (Lindsay et al., 2012).

As a strategy to overcome the so-called low levels of criticism of older adults, Vines et al. (2012) employed questionable concept cards to discuss new concepts for banking and financial services. Each card depicted deliberately provocative designs intended to encourage criticism and capture older adults' ideas.

Beside these main strategies, some other important guidelines for engaging older adults in PD teams and processes can be found in the analysed studies, namely:

- Müller et al. (2015) suggest the use of a reputed helper, someone enjoying a reputation amongst participants of being highly trustworthy, who might act as a door-opener;

- Lindsay et al. (2012) recommends engaging older adults in the PD process as soon as possible, being flexible but also providing some guidance and structure, in order to help them maintain focus. As the authors point out, "*the topic of conversation can drift and the discussion skips important aspects of the design domain"* (Lindsay et al., 2012, p. 1201);

- Alaoui et al. (2014) also emphasize the need to involve older adults from the beginning of the process, stressing out the need to convince them about the usefulness of the project to ensure their engagement and motivation;

- Haak et al (2015) and Kopeć et al. (2018) agree in the importance of participants empowerment, by letting them make decision about the PD process (like decide on sessions topics, for example) or, in a more deeply way, truly cooperate within intergenerational contexts of co-design through a co-design contest;

- Haak et al (2015) also suggests the importance of promoting a supportive environment so all participants would feel safe and comfortable sharing ideas and information; communicate in a meaningful way by speaking slowly, clear and accurately; make smaller groups of participants, to facilitate discussion and ideas generation; and assign homework tasks in order to stimulate participants to be active, creative and motivated.

3.3. *Participation methods*

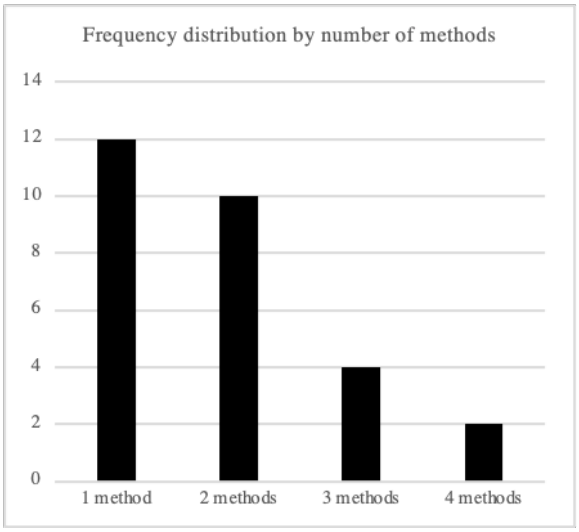
In the analysed studies, older adults were integrated into the PD processes mainly through workshops, interviews and user evaluation tests (cf. Table 4), and mostly through a combination of two to four different methods (cf. Graphic 1). According to, the most frequent situation is the simultaneous use of two methods (N=10), by combining Workshops with Interviews or User evaluation tests (cf. Graphic 1, Table 5).

In Workshops, researchers engaged older adults in discussions and co-design activities, such as the ones introduced in the previous section. Workshops itself have

different formats, durations, frequency and number of participants, and were used in different phases of the PD process, but mainly to brainstorm and elicit requirements (e.g. Hepburn, 2018; Jelen et al., 2019; Pedell et al., 2017; Volkmann et al., 2019), and to design and prototype (e.g. Giorgi et al., 2013; Widyanuri & Octavia, 2015). In Rogers et al. (2014), workshops were used throughout the whole PD process.

Table 4. Total studies coded (N) and total studies uniquely coded (UC) by participation method

Participation Methods	**Studies**	**Nº of Studies *(N)***
Workshops	(Bergvall-Kåreborn et al., 2010); (Ferati et al., 2018); (Giorgi et al., 2013); (Haak et al., 2015); (Hepburn, 2018); (Hornung et al., 2017); (Jelen et al., 2019); (Kopeć, Nielek, et al., 2018); (Mincolelli et al., 2019); (Müller et al., 2015); (Pedell et al., 2017); (Raju, 2018); (Rice & Carmichael, 2013); (Rogers et al., 2014); (Sengpiel et al., 2019); (Vines et al., 2012); (Volkmann et al., 2019); (Widyanuri & Octavia, 2015)	*N=16 (UC=7)*
Interviews	(Alaoui et al., 2014); (Duh et al., 2016); (Giorgi et al., 2013); (Hornung et al., 2017); (Mincolelli et al., 2019); (Müller et al., 2015); (Pedell et al., 2017); (Sengpiel et al., 2019); (Volkmann et al., 2019); (Widyanuri & Octavia, 2015)	*N=10 (UC=1)*
User evaluation tests	(Duh et al., 2016); (Jelen et al., 2019); (Orso et al., 2015); (Sengpiel et al., 2019); (Volkmann et al., 2019); (Widyanuri & Octavia, 2015)	*N=6 (UC=0)*
Focus Group	(Bergvall-Kåreborn et al., 2010); (Jelen et al., 2019); (Sengpiel et al., 2019); (Sorgalla et al., 2017)	*N=4 (UC=0)*
Questionnaires	(Bergvall-Kåreborn et al., 2010); (Biocca et al., 2017); (Orso et al., 2015); (Volkmann et al., 2019)	*N=4 (UC=0)*
Meetings/Assemblies	(Biocca et al., 2017); (Giorgi et al., 2013); (Lindsay et al., 2012); (Müller et al., 2015); (Sorgalla et al., 2017)	N=4 (UC=1)
Hackathons	(Balcerzak et al., 2017); (Kopeć, Balcerzak, et al., 2018); (Kopeć, Nielek, et al., 2018)	*N=3 (UC=2)*
Probes	(Bergvall-Kåreborn et al., 2010); (Pedell et al., 2017)	*N=2 (UC=0)*



Graphic 1. *Frequency distribution by number of different methods*

Table 5. *Participation methods by analyzed studies*

Analysed study	Participation methods
(Alaoui et al., 2014)	Interviews
(Balcerzak et al., 2017)	Hackathons
(Bergvall-Kåreborn et al., 2010)	Workshops, Focus Groups, Questionnaires, Probes
(Biocca et al., 2017)	Meetings/Assemblies
(Duh et al., 2016)	Interviews, User evaluation tests
(Ferati et al., 2018)	Workshops
(Giorgi et al., 2013)	Workshops, Interviews, Meetings/Assemblies
(Haak et al., 2015)	Workshops
(Hepburn, 2018)	Workshops
(Hornung et al., 2017)	Workshops, Interviews
(Jelen et al., 2019)	Workshops, User evaluation tests
(Kopeć, Balcerzak, et al., 2018)	Hackathon
(Kopeć, Nielek, et al., 2018)	Workshops, Hackathon
(Lindsay et al., 2012)	Meetings/Assemblies
(Mincolelli et al., 2019)	Workshops, Interviews
(Müller et al., 2015)	Workshops, Interviews, Meetings/Assemblies
(Orso et al., 2015)	User evaluation tests, Questionnaires
(Pedell et al., 2017)	Workshops, Interviews, Probes

(Raju, 2018)	Workshops
(Rice & Carmichael, 2013)	Workshops
(Rogers et al., 2014)	Workshops
(Sengpiel et al., 2019)	Workshops, Interviews
(Sorgalla et al., 2017)	Focus groups, Meetings/Assemblies
(Vines et al., 2012)	Workshops
(Volkmann et al., 2019)	Workshops, Interviews, User evaluation tests, Questionnaires
(Widyanuri & Octavia, 2015)	Workshops, Interviews, User evaluation tests

As stated by Volkmann et al. (2019, p. 101), "*Interviews are an important method in an HCD development process, especially in the beginning"*. In fact, interviews, particularly in a semi-structured format, were used by many studies at the early stages, to gather requirements and understand needs and expectations (Alaoui et al., 2014; Duh et al., 2016; Pedell et al., 2017; Sengpiel et al., 2019; Volkmann et al., 2019; Widyanuri & Octavia, 2015) and to gain insight on participants daily lives (Giorgi et al., 2013; Müller et al., 2015). In two studies, however, interviews were also used in the testing phases (Mincolelli et al., 2019; Pedell et al., 2017).

Six studies performed User evaluation tests, assessing usability, user experience (UX) and design (Duh et al., 2016; Jelen et al., 2019; Orso et al., 2015; Sengpiel et al., 2019; Volkmann et al., 2019; Widyanuri & Octavia, 2015). In Orso et al. (2015), it is worth mentioning the use of an illustrated questionnaire to facilitate the evaluation of the interface by older adults. Also noteworthy is the use of an "Wizard of Oz" evaluation by Volkmann et al. (2019). This method allows testing the usability and UX of an interface or system, at very early stages of its development, since the responses to the user's actions do not need to be already programmed, being manually provided by a "Wizard" without users being aware. In the case of this study, participants were given the task to record a story with the provided interface and assistance was provided by a moderator.

According to Bergvall-Kåreborn et al. (Bergvall-Kåreborn et al., 2010), focus groups hold advantages for assembling data on life experiences, beliefs, attitudes, and group interaction, thus being an adequate method at the beginning of the PD process. Sengpiel et al. (2019) also used focus group in the "*analysis phase"*. Jelen et al. (2019) and Sorgalla et al. (2017) used the method later in the process, namely for discussing prototypes.

Questionnaires were used by four studies, but with different goals. In Volkmann et al. (2019) and Biocca et al. (2017), questionnaires targeted demographic and personal information (such as personal and social profile, cultural and recreational interests), affinity for technology and computer literacy. Biocca et al. also surveyed

opinions about the concerned technology – the STAGE platform. Bergvall-Kåreborn et al. (2010), on their turn, applied questionnaires after the focus group sessions, in order to understand the representativeness and level of importance of the identified needs and requirements, namely trough a Likert scale. At last, Orso et al. (2015), applied a set of individual questionnaires to survey older adults' preferred TV content and, later in the PD process, used them again, in an illustrated format, to evaluate the application interface, ensuring that icons and symbols used were clear.

As far as Meetings/Assemblies are concerned, and in the studies of Lindsay et al. (2012) and Sorgalla et al. (2017), it was hard to understand the differences when compared to the Workshops, which appeared to be none. Despite this, the fact is the authors designated the work sessions as meetings and not workshops, and this was respected. In the other studies, differences from the workshops were clear, since the sessions did not intend to boost activities or discuss issues. Instead, sessions aimed to introduce the projects to the participants, generate opportunities for researchers to start establishing a more close connection with them by making small talk (Giorgi et al., 2013; Müller et al., 2015) and also allow to apply questionnaires, as in the case of Biocca et al. (2017).

Kopeć, Nielek, et al. (2018), on their turn, included an entire step in the SPIRAL method dedicated to intergenerational interaction. In this step, which grounds on contact theory, a miniature of the whole design process is put into action, by involving different age people in hackathon teams. According to the authors, "*the intention of this step is to provide an opportunity for immersion of older adults in the development process and facing stereotypes from both sides of the process*." (Kopeć, Nielek, et al., 2018, p. 54).

Hackathons have already been addressed in this paper, as the method is particularly suitable for engaging intergenerational teams in PD processes. Balcerzak et al. (2017), Kopeć, Nielek et al. (2018), and Kopeć, Balcerzak et al. (2018) describe the use of hackathons in studies aiming to motivate older adults to participate in PD processes, stating that the method proved to be effective, benefitting both younger programmers and older adults.

Finally, probes were used in two studies "*to encourage and empower subjects to collect data themselves. The participants use probes to provide some insight, at their discretion, about their daily lives*." (Pedell et al., 2017, p. 14). Pedell et al. (2017) asked older adults for probes concerning the use of technologies in the real-world participants settings. Bergvall-Kåreborn et al. (2010, p. 340) distributed cameras and notebooks by the participants and asked for photos of "*situations where they felt secure or insecure; when they were enjoying a social occasion, or felt hindered from participation in a social occasion"*.

The results of the SRL informed the ways in which older adults are being engaged in LOCUS, as informants and co-designers, as discussed next.

4. Discussion

LOCUS aim to engage inhabitants, stakeholders and visitors of Amiais – a small Portuguese rural village – through the whole process of designing, developing and evaluating an IoT system to support playful intergenerational exploration of Amiais CH. Amiais has 15 permanent inhabitants, most of them aged between 60 and 90 years old, with low literacy levels and ICT skills.

The LOCUS approach comprises a set of five main phases, namely: 1) Ethnographic Immersion; 2) Reflection and Preparation; 3) Agile and Participatory Design and Development; 4) Evaluation; and 5) Sustainability and migrability model. So far, the first phase is complete, and the second phase was starting when the COVID-19 pandemic installed. This discussion will only focus on the methodologic approaches, methods, strategies and instruments used on phases 1 and 2.

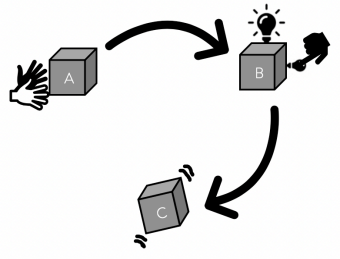
The first phase was intended to establish synergies with stakeholders (government entities, cultural and recreational associations), getting to know the inhabitants, their daily-life, life stories, motivations and wishes, and earn their trust. Considering these goals and the SRL results, we decided by applying semi-structured interviews to the main stakeholders (the Mayor, the President of the Parish Council and the Presidents of two local Cultural Association), in which we presented the project, gain an understanding of the socio-economic and cultural contexts, and started to establish partnerships.

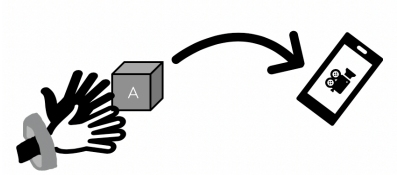
These contacts allowed us to identify, as suggested by Müller et al. (2015), someone that could act as a door-opener. As such, and even though the first contacts with the inhabitants took place as part of informal visits to the village as perfect strangers, the President of the Parish Council played a key role in the process of bringing the team closer to people.

With the progression to the second stage of the project, the activities with people became progressively more structured, assuming the form of workshops with defined objectives and strategies, to which people were formally invited. The ultimate goal is the co-design of playful and immersive scenarios and narratives to be implemented in the IoT system.

Following the strategy proposed by Hornung et al. (2017) and Müller et al. (2015), the workshop sessions started by being cake, coffee (in fact, tea!) and talk type session. In the two sessions that took place until the COVID-19 pandemic started, through paper-based activities and by enacting situations and playful activities, older adults taught us about the multiplicity of aspects of their cultural heritage. During these workshops, we found sometimes difficult to keep participants focused on the discussion topics, as reported by the SRL studies. As such, we tried to find some balance between flexibility and guidance, as suggested by Lindsay et al. (2012).

For future workshops, the activities will address the barrier of low ICT skills and the eventual difficulties envisioning new technologies or engaging in creative thinking around abstract and intangible issues that older adults could have, as reported by Duh et al. (2016), Linday et al. (2012) and Rogers et al. (Rogers et al., 2014). For that purpose, mobile devices and applications would gradually be introduced and used in the workshops to access diverse multimedia content, prompted by physical tags or objects. Besides, two prototypes are being developed, which will allow for the experimentation of two different scenarios of interaction with physical objects, also involving a mobile application and a wearable device (cf. Figures 2 and 3), as in the IoT system to be developed.





Figures 2 and 3. *Interaction scenario 1: when Object A is manipulated in a certain way, it lights up a light in Object B, that when is turned off by the user makes Object C vibrate; Interaction scenario 2: Bracelet acknowledges Object A movement and communicates with a mobile phone, that plays a short video*

It is worth noting that, following Lindsay et al. (2012) recommendations and Rogers et al. (2014) approach, older adults were engaged since the beginning and throughout the whole PD process. Besides, and as recommended by many of the SRL studies (Hornung et al., 2017; Jelen et al., 2019; Kopeć, Nielek, et al., 2018; Müller et al., 2015; Orso et al., 2015), workshops were always intergenerational, since participants included younger researchers, older adults, their children and grandchildren. In the upcoming phases of co-design and co-development of the IoT system, older adults will be paired with young researchers, designers and developers, and suitable ways of cooperation will be found.

Finally, and considering the lack of self-confidence of older adults acknowledged by Kopeć, Nielek, et al. (2018), the LOCUS team endeavoured to make older adults feel empowered by being indispensable elements of the project team, as it was stressed out often during workshops.

Conclusion

The SRL conducted intended to answer the following question: How older adults have been integrated and engaged into technology participatory design teams and processes? This paper focused on the persecution of two of the five main goals of the research (as described in section 3.1), namely: To identify the most used methodologic approaches and methods to integrate older adults in intergenerational teams for the PD of technology; and To understand the challenges that researchers face when involving older adults in PD teams and processes and which strategies are best suited to overcome those challenges, by promoting effective engagement.

Results showed that the most common methodological approaches described by the studies were PD and Living Labs. Regarding methods, the analysis shown that older adults were integrated into the PD processes mainly through workshops, interviews and user tests, and mostly through a combination of two methods, combining workshops with interviews or user tests.

It was observed that older adults are capable and many times eager to engage in participatory design activities, although working with them can be different from working with younger adults. In fact, a set of problems or barriers were elicited from the corpus of analysis, namely the lack of ICT skills, difficulties envisioning new technologies and/or engaging in creative thinking around abstract and intangible issues, difficulties in maintain focus on tasks or discussions, and age-related stereotypes among technology designers and developers. It was also possible to elicit a set of strategies to overcome these challenges.

As with many SLR, this study relied on a limited number of databases for searching potentially eligible documents and on a limited number of researchers to undertake all the SRL procedures, which one can consider as limitations, despite the effort made to make all decisions transparent to the reader. On the other hand, this particular paper only presents part of the analysis and results, therefore providing a partial answer to the SRL's research question.

However, the entire SRL results gave us an insight into the practices to engage older adults in participatory and intergenerational design teams and processes, working with and learning from them in actual settings, informing how older adults are participating and being engaged in the LOCUS project.

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