PARTICIPATORY DESIGN METHODS IN THE DEVELOPMENT OF PRODUCTS AND ENVIRONMENTS FOR ELDERLY USERS WITH PHYSICAL IMPAIRMENTS

Ana-Maria Adina ŞUTEU (BĂNCILĂ), Constantin BUZATU
Transilvania University of Brasov, Romania

Abstract. It has been observed that the incidence of impairment increases significantly with age, resulting in a large social group that stands the need for specially designed systems intended to improve their quality of life. Increasing age is often associated with a rise in other diseases such as osteoarthritis, reduced hearing and vision, memory loss, physical impairments and general frailty that lead to mobility problems. Thus results one of the major challenges that is keeping the older adults independently mobile, most commonly solved by the employment of assistive technologies. On the other hand, research has identified a multitude of factors that hinder the acceptance of assistive technology, people often holding a negative view towards such technologies and being reluctant to adopt them. Consequently, it raises the need to consider user-inclusive requirements which address psychological and socio-emotional needs of users. Taking into consideration these factors, the paper presents the application of participatory design methods in the development of products and environments intended to improve the activity and overall live quality of the elderly. Furthermore, a case study is conducted in order to establish the best solution for the design of a new mobility aid that would increase mobility and ease of movement and, at the same time, is socially accepted by the group of older adults.

Keywords: participatory design, elderly users, user-centred design

1. Introduction

Life expectancy has increased dramatically in the twentieth century. Low rate of infant mortality, major medical advances and better health care have led to increased life expectancy, and thus increase the number of elderly people, especially those of extreme age (85 years old and over). In the European Union, people aged 65 and older make up about 20% of the population and are representing the fastest growing segment [1, 2]. It has also been observed that most disabling conditions are due to a variety of causes and acquired at various stages in the life course. The incidence of impairment increases significantly with age [3] and these declines in elderly body functions should be considered when designing products and environments that meet the specific needs of this social group.

Statistical data shows that in the countries of the European Union there is an aging tendency, leading to a significant increase of elderly population in the next decades. It can also be observed an increased level of physical limitations with age (Figures 1 and 2).

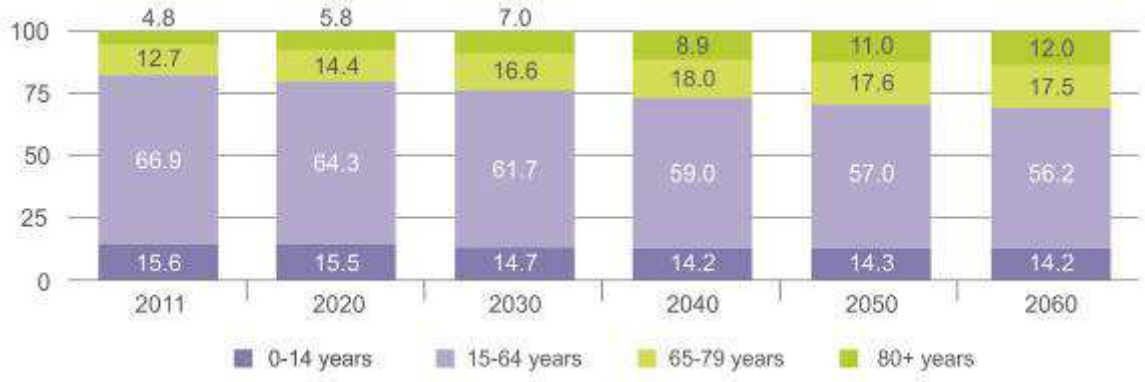

Figure 1. Population structure by major age groups, EU-27, 2011-2060 (% of total population) [2]

The assistive technologies, i.e. systems that increase the ease and safety whit which an user performs an activity or task, include a wide range of products, starting with low technology items, such as ramps or grab bars, and ending with the sophisticated devices of a smart house.

Faced with a slow deterioration in their abilities, yet wishing to remain independent, for many older people the use of assistive technologies makes the difference between maintaining their quality of life and losing their independence and self-respect.

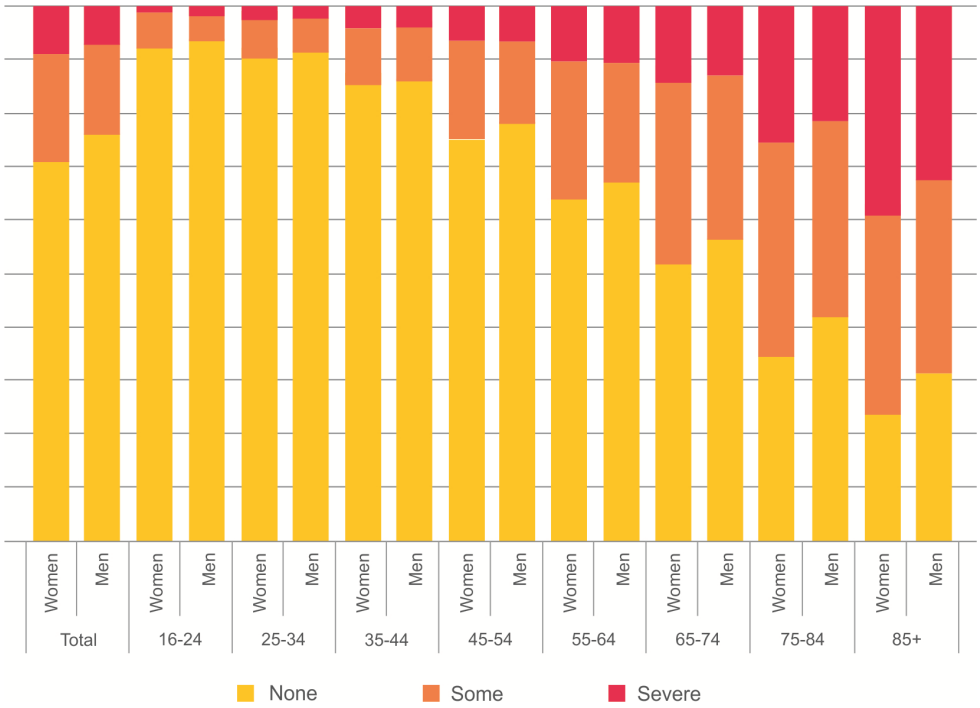

Figure 2. Activity limitation by sex and age, EU-28 (% of population aged 16 or over) [4]

However, it would be a misconception to assume that elders will use a technological aid just because they need it [5, 6]. In [6] and [7] emerges the problem that adults will invest time and resources in adopting new technology only if they can see a clear benefit for themselves. However, a more fundamental issue might revolve around perceived negative socio-emotional consequences of using assistive aids, thus understanding the expectancies is necessary for effective assistive services and products design [6]. In order to enhance the elderly users' willingness to adopt and use assistive technologies, the products should be useful, useable, desirable and, most importantly, be perceived as compatible with their life-style [5, 6]. In this sense, if assistive aids activate negative emotions, older adults might prefer to avoid their use despite their perceived usefulness, thus creating a challenge for designers to maximize the usability without negatively impinging upon users' psychological and socio-emotional needs for social acceptance, belonging and self-esteem [6].

Considering all the above, it emerges the need for developing new products and environments or implementing various changes in the configuration of existing solutions to better fit these new physical constraints. The term *universal design* describes the concept of designing products and built environments that are usable to the greatest extent by everyone, regardless of age or ability [8], but in order to develop a product that serves a specific need of specific group of users, their opinion on the matter has to be considered. Thus, given the appropriate tools or methods they can become articulate and even creative [9].

2. Participatory workshops as design methods for developing products fit for the elderly

2.1. Participatory design

In the case of participatory design, the end users of the potential product are invited to cooperate with the team of designers, researchers and developers during several stages of the creative process: the initial problem definition (in order to help define the problem and to generate ideas for possible solutions), in the development phase (by helping evaluate the proposed solutions) up to the final testing phase of the process. Thus, by the means of participatory design, a collaborative partnership is created between the team of experts and the end users group [10]. The advantage of using such method is that it can offer a more in-depth insight into an issue, giving the researcher an *insider view*, offering a more valid description of people's experiences than could be achieved by simply presenting them with pre-defined ideas and asking for an evaluation [6].

The participatory workshops were first defined as sets of theories, practices, and studies that involved the end users as full participants in the process [11]. The users' participation was further

considered to ensure that the design outcomes would fit appropriately with the way people would use the final product [12].

While in the past, the design and development process was mainly conducted by researchers and there were only a few attempts to involve future users, nowadays participatory design spans across a broad spectrum of domains and makes use of a broad repertoire of tools (material components used in participatory design activities) and techniques (describing how the tools are put into action), serving different purposes [13], being increasingly used in projects targeting healthcare services and assistive technologies at home [14].

2.2. Participatory workshops with elderly participants

Reviewing the literature it has been observed that participatory design becomes an often used tool when designing for the elderly. Although in the past they were rarely considered, collaboration between the researchers and designers on one hand and the elderly end users on the other hand is becoming more present.

Thus, L. Robinson et al. propose in [15] a three-stage participatory design process in order to create acceptable and effective prototype technologies to facilitate independence for people with dementia, involving them and their caregivers.

R.D. Ellis and S.H. Kurniawan in [16] describe the goal of making a website more user-friendly for elderly users by employing the means of participatory design. They also discuss specific design improvements and general design guidelines for older WWW users.

In [17] Marije Kanis et al. present a participatory design study of an ambient assisted living system for monitoring the daily activities of elderly residents by using an interactive dollhouse as a method of including the elderly in the design and requirements gathering process.

S. Lindsay identifies in [18] four central issues that participatory design approaches need to address when involving elderly participants, describing an approach to early engagement in design with older people.

As seen above, the involvement of the elderly end users in the design process leads to the development of more suitable products or environments that increase their level of independence and overall life quality.

In this sense, A. Bright and L. Coventry used in [6] a qualitative method of data collection that involved the use of different techniques in order to gather user's requirements, with an emphasis on the social context. The data collection process was an iterative one, additional participants being recruited according to previously obtained data, the process continuing until additional selection of participants did not lead to new results. The processed data was further used in the DALi (Devices for Assisted Living) project that aims to develop a semi-autonomous, intelligent mobility aid for older adults, which would support navigation in crowded environments.

3. Case study

3.1. Application of participatory design model in developing a new walking aid for elderly users with low mobility

One of the techniques used for gathering information from the users was the Usability, Safety, Attractiveness Participatory (USAP) design model (Figure 3) [19].

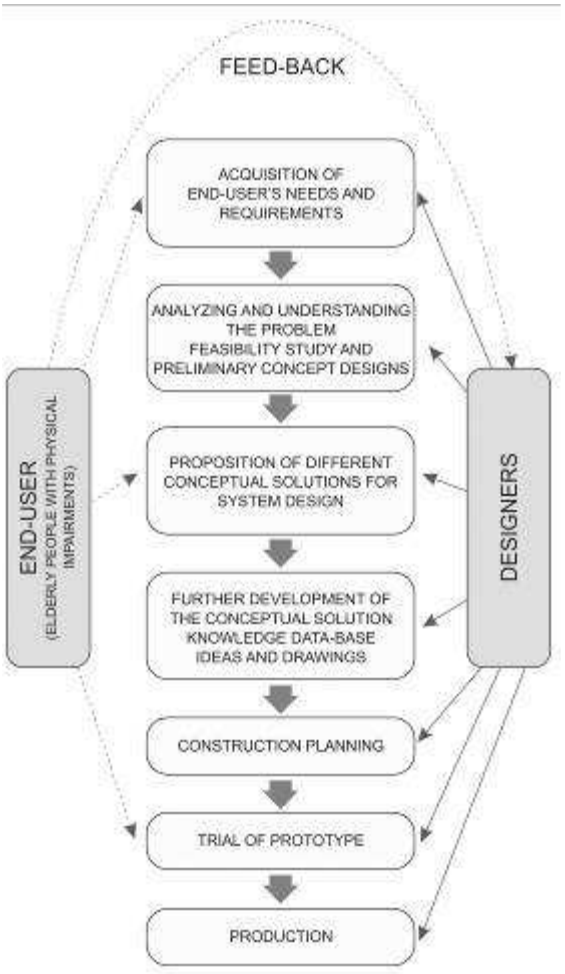

Figure 3. Involvement process in the USAP design model [19]

The elderly dealing with changed capacity, reduced ability and increased needs require the

same accommodations in the late life that they found in earlier years. Homes must provide solutions that address these distinctions in capacity, ability and need for daily living.

In this sense, USAP design model is a participatory design technique that involves users directly and facilitates the cooperation between the designer and the participants in order to reach more usable, safe and attractive products.

In order to obtain the best results that would fit a wide range of users, a group of elderly participants with different physical abilities, ranging in age from 60 to 80 were directly involved in the development process of a walking aid assistive technology. The selected group would participate in three steps of the design process: obtaining important data about the users' needs and design requirements, proposition of alternate, better fitted conceptual solutions and trial of the prototype.

3.2. Group participatory workshop with elderly participants

Taking into consideration the framework presented in [13], but also the difficulties in obtaining information from the elderly users [19], a new method for a participatory workshop was proposed for the first stages of the product development process. Based on three main types of activities – making, telling and enacting – a face-to-face workshop was proposed, in which the elderly participants would be faced with a combination of techniques including brainstorming, collages, cards and even enactment of current and future situations [13], listed in Table 1. The objectives of the workshops were to generate ideas for developing a new walking aid assistive device that is adaptable to the needs of older users with physical impairments. Due to the difficulties generated by age, each workshop session was kept brief (approximately one hour), thus resulting the need for several sessions.

In the first session, the participants were given a sheet of paper that was separated across the middle with a horizontal line and they were asked to make a collage representing a timeline of their daily activities, including their morning routine, mobility around the house, interaction with walking aids, keeping above the line the positive aspects of their current situation and below the line the negative ones [20] (Figures 4 and 5).

Table 1. Activities, tools and techniques used in the workshop sessions with elderly users

Activities	Tools and techniques
Making tangible things	2D collages: timeline of the experience with the current walking aid
	2D mapping: provide best scenario using a patterned background of room floor
Talking, telling and explaining	Cards: organize and categorize activities
Acting, enacting and playing	Participatory enactment: daily home routine

The participants were given a group of 30 pictures of different activities and a set of three cards representing emoticons, in order to facilitate them in expressing their opinions, experiences and emotions regarding walking aids. The group of elderly participants was asked to choose among the pictures, the ones that best represented their current experience and tape them to the provided paper. The centre line represented a timeline for daily activities. The participants were asked to place provided images either above the line, indicating positive perceptions or below the line indicating negative perceptions. The degree of positive and negative increased with the distance from the line.

In the second exercise, the participants were given a piece of cardboard with a patterned background representing a room floor and a set of cards depicting different activities and workstations.

They were asked to arrange the cards on the patterned background in the way they would envision their home space should look like in order to facilitate their access and present an ideal scenario for their daily activities.

Figure 4. Group of images provided for participants in the participatory sessions

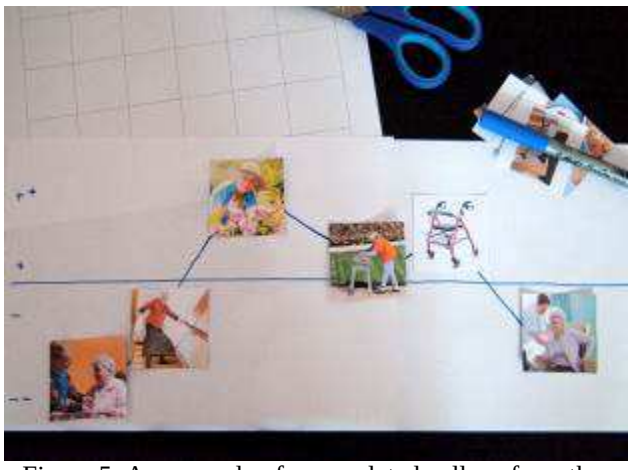

Figure 5. An example of a completed collage from the participatory sessions

Lastly, as a participatory enactment exercise, the participants were asked to perform usual daily activities in the home space, with the intention of observing their interaction with the space and the difficulties they encounter, revealing other requirements, not identified in the previous sessions.

3.3. Results and further discussions

The sessions focused on finding a walking aid that would best accommodate the needs of elderly users. After conducting the participatory workshops and gathering information from the participants, several features were determined as important when developing the new assistive product (Table 2).

Table 2. Identified needs and requirements

Identified users needs	Mobility aid features	Design requirements
Independence	Easy to use system; Provide ease of movement; Adaptable to the user's needs; Less personal assistance for the user.	Allow independence from caregivers; Approachable technology, easy to learn; Personalization possibilities.
Comfort	Easily reachable; Provide good access form both front and back; Soft and warm areas of contact; Easily recognizable by users with impaired vision.	Not openly displayed technological capability to minimize perception of assistive nature.
Safety	Reliable support; Reduce fear of falling; Provide safety belts; Provide safety breaks.	Allow exercising daily activities in a safer, more relaxed manner.

The generated ideas were based on experience, allowing users to imagine solutions based on their own needs and that are more relevant.

After evaluating the obtained results, guidelines for developing a more reliable walking aid were underlined, opening the way for further discussions with the group of participants in order to reach the solution that best accommodates their needs. Thus, after summarizing the answers, it has been observed that the walking aid must be reliable, provide easy gripping, help the user stand or sit, provide safety features and allow mobility with less or even none personal assistance. For better understanding of the efficiency of future design for the new walking aid assistive device, each participant was asked to compare their current assistive walking aid with the solution they envision would best fit their need of mobility, resulting in a new set of guidelines for the product design.

In the next stage, the group of elderly participants will be asked to evaluate the proposed solution and, in the sequel, test the prototype.

4. Summary

In this paper the application of participatory design methods in the development of products and environments meant to improve the activity of the elderly users was presented. A case study was considered in order to present the application of participatory workshops intended to establish the best solution for a new walking aid assistive device, adaptable to older users with physical impairments. Using the tools and techniques of the participatory method, a group of elderly participants was asked to evaluate their current situation involving walking aids in their daily activities and also to present the ideal solution adapted to their needs. The results obtained from the participatory sessions were further used to develop a set of guidelines for design proposals for a new walking aid assistive device that would serve more efficiently the needs of the elderly users.

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