Digital Inclusion of Nursing Home Residents: A Usability Evaluation of the Digital Kiosk siosLIFE™

Carla V. Leite[1,2,3][a], Daniel Carvalho[1,2,4], Ivone Almeida[1,3,5], Sofia Nunes[1,2,4] and Ana Margarida Almeida[1,2][b]

[1]*Department of Communication and Art, University of Aveiro, Aveiro, Portugal*
[2]*Digital Media and Interaction Research Centre (Digimedia), University of Aveiro, Aveiro, Portugal*
[3]*Department of Education and Psychology, University of Aveiro, Aveiro, Portugal*
[4]*Faculty of Arts and Humanities, University of Porto, Porto, Portugal*
[5]*Research Centre on Didactics and Technology in the Education of Trainers (CIDTFF), University of Aveiro, Aveiro, Portugal*

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Abstract: The fast demographic ageing and technological progress are leading to a greater demand to develop digital solutions that can foster communication, information, and socialization of the elderly population. In the past decade, kiosks have been used to prevent digital exclusion and to promote the quality of life of this age group. This paper analyses siosLIFE™, a digital kiosk that is gradually getting attention from the public. The methodology adopted consisted in a usability test with guided tasks, using a cognitive walkthrough and think aloud protocol, with participants being residents from a nursing home. The results show that siosLIFE™ complies with some usability recommendations, but there are several improvements regarding the interface, contents, integration of support systems, and assistive technologies that can be made.

1 INTRODUCTION

The use of digital services has changed drastically since the early nineties, focusing on personal entertainment, leisure and social contexts, instead of being used solely for professional tasks (Lowgren, 2008). On the one hand, it allows and promotes new sociability; on the other hand, it can lead to the development of stereotypes and lead to exclusion (Hamelink, 2000; Gorman and McLean, 2009). This informal adoption plays an ever-increasing role, in such a way that the global digital inclusion of all age groups is currently viewed as a societal challenge. The elderly population constitutes the age group with the lowest usage of digital media (Keränen et al., 2017), with this fact being attributed to different factors, such as: the lack of opportunities to access and becoming familiar with it, as a consequence of economic, cultural and educational variables, the inadequacy of digital platforms regarding impairments, needs, and motivations of to this particular age group and the physical and psycho-sociological changes resulting from the ageing process (Pfeil et al., 2009).

One of the main accomplishments of humanity, strictly related to the progress in the health, education, economic, political and social fields: the increase of longevity; along with the decrease of the birth rate in the last decades, are generating a worldwide demographic aging phenomenon (Cabral et al, 2013; Chau et al, 2012), especially noticeable in developed countries (Nazareth, 2009). The World Health Organisation estimates that, until 2050, the proportion of people aged 60 or over will exceed 30% in many countries (WHO, 2015).

Despite the fact of the aging process being naturally universal, instigating changes in several human dimensions, it is also individual, determined by the unique experiences and particularities of each individual, thus the very definition of the elderly person becomes imprecise (Rocha, 2007). Three relevant components can be highlighted in this

[a] https://orcid.org/0000-0001-5803-2775
[b] https://orcid.org/0000-0002-7349-457X

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process: physiological, social and psychological ageing (Ferreira, 2013; Paúl, 2005).

Interactive systems should be able to respond to different settings and support the behaviour of the users, considering their struggles and needs; in particular touch screen systems, widely used in kiosks may constitute a promising and viable option considering its capabilities (Moti et al., 2014; Fonseca, 2011), for the elderly population. The research regarding this subject, faces the elderly population as part of the network society, promoting their digital empowerment and inclusion (Wu et al, 2015).

In this study, an interactive touch kiosk was analysed – siosLIFE™, composed of a multimedia screen, a Kinect sensor, and a card reader, designed to be used in nursing homes.

Its main goal is to promote cognitive stimulation and physical exercise to the elderly population, through games, video calls, music, and drawing (ScaleUpPorto, 2016). A usability study was conducted in order to analyse the digital inclusiveness of this platform.

2 CONTEXTUALISATION

In the Portuguese context, there is a statistical rise of the population over 65 years' old which, at the moment, which is the reference for the chronological age of the elderly population (WHO, 2002). In 2015, amongst the Portuguese from 65-74 age group the average of the computer and Internet usage was 29% (INE, 2015). It should be noted that this official report does not present data for people aged 75 or over. However, it is possible to conclude from other international studies, that this age group uses digital media even less (Keränen et al, 2017). In addition to the exclusion factors felt by the younger peers, they are presented as barriers: the difficulty felt and the lack of access skills, even if the technology is at their disposal (Ferreira, 2013; Friemel, 2016). When a population is deprived of digital literacy, there is a gap in the appropriation of the language, tools and conceptual models, which are important to understand and to use digital media (Ferreira, 2013). Moreover, changes resulting from the ageing process may interfere with the ability to use digital media, so it is mandatory to properly consider the specific needs of the elderly population during the survey of requirements and design of a digital system (Ferreira, 2013). The benefits of using digital media by the elderly seem to focus mainly on social interaction. According to Dias (2012), the elderly population value communication with family and friends, along with interaction between different age groups. The promotion of intergenerational relationships can occur through discussion groups, chat or email, as well as recreational activities such as interactive games. The opportunities for communication, access to information and entertainment generated by digital media, may motivate the elderly to leave home and participate in society (Chaumon et al, 2014). They can also help them to focus on the future and develop and invest more in their own life projects, and also support the performance of daily life activities, health monitoring and safety (Azevedo, 2013; Ashok and Jacko, 2009; AGE, 2008; Dickinson and Gregor, 2006; Blit-Cohen and Litwin, 2004).

The elderly population can be involved in the development of these technological solutions, just as it already happens with other age groups. Those tools should be oriented towards respect for the individual, protection and fulfilment of human rights, following principles of universality, non-discrimination and equality, in order to achieve participation and inclusion (AGE, 2008).

3 siosLIFE™ DIGITAL KIOSK

As stated previously, digital platforms can help fighting limitations resulting from ageing (Blaschke et al., 2009), contributing to a better quality of life of the elderly (Czaja and Lee, 2007). These are the two aims of the siosLIFE™ platform, through the promotion of cognitive stimulation and physical exercise with games, contact with family and relatives, music broadcasting, drawing and painting, access to news and religious contents, contextualized with the preferences of the Portuguese audience (ScaleUpPorto, 2016).

The project was born in 2014 as a result of the efforts of two graduate students who applied for a business ideas competition (ScaleUpPorto, 2016). In 2016, siosLIFE™ won the "Health and Wellbeing" category in the project Porto 3i, which allowed the company to work directly with some institutions in Porto, so as to validate the system, and since then, the impact of siosLIFE™ is being measured and followed by an evaluation commission from School of Health Sciences - Polytechnic of Porto (ScaleUpPorto, 2016). The creators provided the data needed to the authors of this paper, and the conclusions of this study contribute for the new versions that will be released. Bearing in mind the particularities of the siosLIFE™ system, it was designed to be integrated mainly in institutions such as nursing homes, day care and

social centres. However, we consider that its integration may be relevant in other places and services, such as libraries, parish councils and other areas where the elderly population is likely to use it. When carrying out this study, the project was available in 91 institutions, reaching around 1200 elderly people.

The terminal of the user platform consists of a touchscreen, a card reader and a Kinect, which are portable and resistant, as shown in Figure 1. Each user owns a numbered card to log into their account. The institution provides the cards and fills in their data online. The software entirely depends on the internet connection and has artificial intelligence, adapting the level of the games to the user's performance.

Figure 1: SiosLIFE™ digital kiosk.

4 PROCEDURE

siosLIFE™ is divided into three user profiles with specific functionalities: elder user, institution and family. This study is focused solely on the first profile created for the elderly people usage, called the 'user' profile from now on.

The authors of this study were granted access to the siosLIFE™ system, with the most recent software version at that time, in an institutional context, in the nursing home that promotes more initiatives of active aging in Portugal. They had contact with it several times, in order to analyse, evaluate and gather data. After analysing the system, it is important to orient and map out the scope of the study. Formulating the starting points allows expressing what is intended to be known, elucidated and better understood, having in consideration clarity, viability, and relevance (Quivy and Campenhoudt, 2008). Trying to attend those criteria, the following question was drawn:

• *Does siosLIFE™ comply with accessibility, usability and inclusive design for the elderly population?*

A usability test was conducted in December 2017, with two of the researchers present, one reading a guideline of seven tasks, and the other observing and taking notes. The set goal was to test with six participants - three women and three men, who were full-time in the facility and aged over 64. The average age of the group turned out to be 77 years. Moreover, some clinical conditions could be considered exclusion criteria, since they were likely to influence the interaction with the platform, but since the nursing home is a small institution and only few elderly individuals were interested and motivated to participate in the study, their uniqueness were taken in consideration during the tasks completion to avoid their frustration. Three participants had visual impairments, another one had cognitive deficit and two others had mobility limitations (one of them being a wheelchair user and with reduced mobility of the upper limbs).

It was followed a think aloud protocol to be possible to understand their thinking process and experience during the interaction (Hartson and Pyla, 2012). Autonomy, Errors, Time and Path to complete the task were assessed, along with Gestures, Body posture, Facial expression, Comments and Reported difficulties caused by motor, sensorial and cognitive limitations, were the dimensions of the observation grid.

To complete the first task, participants were asked to: adjust the monitor, read the instructions showed in the monitor, log in, confirm who was the user logged in, and visualise the main menu, as illustrated in Figure 2.

Figure 2: Part of Task 1.

For the second task, it was requested to select the Games menu, selecting the required game *Smashing bugs*, illustrated in Figure 3, and play until the objective was completed.

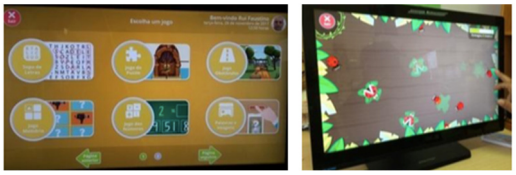

Figure 3: Part of Task 2.

In the third task, participants were asked to go back to the Main menu, select another game *Picking*

fruit that can be seen in Figure 4, then follow the instructions to start and play until finishing the round.

Figure 4: Part of Task 3.

In the fourth task, participants needed to go back again to the Main Menu and select *Listen to music* option, then choose a specific artist they were familiar with, and select a specific song, as shown on Figure 5. Moreover, they were requested to increase/decrease the sound volume.

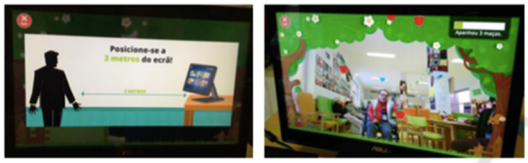

Figure 5: Part of Task 4.

To complete the fifth task, the participants were requested to go back once more to the Main menu and select the *News* option. Afterwards they had to identify the category *Sports* and read a specific section of the soccer news, as illustrated in Figure 6.

Figure 6: Part of Task 5.

The sixth task consisted in going back to the Main Menu once again, but this time to select the *Call* one, then pick a specific contact and make the phone call, as it is possible to observe in Figure 7.
And finally, the user had to log out, removing the card and check the light changes in the NFC reader.

Figure 7: Part of Task 6.

5 RESULTS AND DISCUSSION

All the participants completed the full set of tasks, some autonomously and others with the help of the researcher who was reading the tasks guideline when requested.

The first and last tasks were related to the interaction and customisation of the hardware of the kiosk, so their results are grouped in Table 1.

Table 1: Task 1 and 7 results.

	Completed without help	Completed with help
Log in with card	4	2
Monitor adjustment	3	3
Log out removing the card	1	5

The participant who stated that uses the computer and internet daily in the nursing home, found it easy and quick to log in/out using the card, doing it without help and faster than the average. On the other hand, this participant had difficulty adjusting the screen due to upper limbs mobility limitations and weight of the screen. The other five participants had to use both hands to adjust the screen. Two participants who completed the log in without help removed the card and placed it back repeatedly, in order to check changes in the hardware. They showed satisfaction about the light feedback of the NFC reader. Two participants, who stated that did not use informatic systems autonomously, they were unaware that the log in could be completed using a card. On the other hand, one of the participants comment the fact that the card should keep being personal since it is practical to log in using it. One of the participants searched for feedback on the monitor after the log out, mimicking the log in behaviour.

In the second task, as shown in Table 2, all participants played until the level was finished. Two participants, who stated not to be familiar with informatic systems, continued playing enthusiastically, even after being asked to exit the game because the level was already completed. It was observed that half of the participants did not lean on the wrist while playing.

Table 2: Task 2 results.

	Completed without help	Completed with help
Open Games menu	5	1
Select *Smashing bugs* game	2	4
Play and complete the level	6	0

The navigation for five participants was done by selecting page numbers, and requesting help to do it properly, instead of using the *Next page* button. Only one participant with visual impairment could not read the game information status. Another participant that is illiterate stated that he could not read the captions, so it was only possible to identify the game from the picture since the name was suggestive.

Four of the participants asked for help to change the game (reach the games menu and select a specific one - *Picking fruit*), as can be seen in Table 3.

Table 3: Task 3 results.

	Completed without help	Completed with help
Change game	2	4
Follow start instructions	4	2
Play and complete	3	3

Furthermore, two participants needed help to understand the game instructions, since they needed to stand up and be 3 metres away from the Kinect. Also, the game instructions did not mention the interaction needed, i.e. how to pick the fruit that was dropping from the top of the screen.

Every time this game is selected begins a trial mode to calibrate the sensor, however it does not change the interaction input when the user does not move both hands together as a shell. The participant with cognitive deficit showed to be unsure how to proceed and confusion. The acceptance of the game was high, all the participants enjoyed playing it. Half of them used both hands since the beginning, with two of them clapping when the fruit was virtually close. The participant with severe mobility limitations did not show frustration and tried different interactions methods, even tried to stub the fruit with his head. Half of the participants faced difficulties because of the parallax effect, not knowing where to find the apple in real space according to its virtual representation. Moreover, four participants, including those with visual limitations, could not read their performance from a three metres distance.

During the fourth task completion, both participants with visual impairments and one illiterate, along with another participant, they all could not associate the image of the *Music* menu, moreover they hesitated between the image and the caption as selection input of the singer and the song. Two participants were able to understand how to navigate in the *Music* area using the arrows, what may be explained by their familiarity with the metaphor, since they are mobile and computer users and the applications/software/websites to listen to music commonly follow the same approach, as can be seen in Table 4.

Table 4: Tasks 4, 5 and 6 results.

	Completed without help	Completed with help
Change to *Music* menu	2	4
Select artist and song	2	4
Increase-decrease volume	1	5
Change to *News* menu	4	2
Change to *Sports* menu and select soccer option	4	2
Change to *Call* menu	4	2
Do the call and hang up	4	2

When participants were asked to increase the sound volume, only one managed to do it without help. Another participant, despite identifying the icons related to volume, did not differentiate the icon of increase from the decrease volume. The other participants approached the corner of the screen where the volume buttons are located but could not visualise them. This difficulty may be related to their visual impairments, as well as due to the icons small size and buttons location - lower part of the screen.

The fifth task, related to *News*, was the one causing less general confusion. Four of them recognised the categories on the menu and chose accordingly. Nevertheless, it was noticeable a common navigation error: returning too many times on the "back" arrow, since it is always shown in the same place and has no delay time for the interaction.

Curiously, one of the participants made the gesture (without touching) to flick through the pages and comment that would be a satisfactory input to be developed. Only one participant showed preference for reading the news in the digital format, instead of on paper, while the others were neutral or stated they preferred it on paper.

During the sixth task, related to making the call, four participants completed the steps requested without any help. The participant with cognitive limitations did not recognise the phone icon as clickable and with the call function, so the participant looked at the table and searched for a phone. Only after verbal explanation this participant could complete the task.

6 CONCLUSIONS

The increase of life expectancy and the demographic ageing constitute a growing reality, making it necessary to promote actions focused on active

ageing and on the quality of life of the elderly population. Digital media represent an effective support for the elderly population, with potential benefits in regard to the quality of life of this age group. They can be used as a strategy to compensate for some alterations that may arise from the ageing process; thus, it becomes necessary to assess and adjust them in order to meet the needs and skills of the elderly population (Arch et al., 2009; Ferreira, 2013). It is therefore necessary to adopt an interdisciplinary, innovative, and integrative approach, such as gerontechnology, a field of study that aims to develop and distribute products, environments and technological services that contribute to a better quality of life during the ageing process, promoting health, social participation, and independence of the elderly population (Fozard, 2001).

As societies have evolved, ageing has been the object of several studies, with a clear investment in policies that advocate it as an active and positive experience. These predict continuous opportunities and promote a lifestyle that maintains a healthy body and mind, through good habits of nutrition, involvement in interesting and intellectually stimulating activities, maintenance of self-concept, and maintenance of a social support system, throughout the life cycle (Lima, 2004). It is also relevant to mention that facilitated access to interaction, information and communication, informal learning through the exchange of experiences and the confrontation of opinions should be guaranteed (Rogers, 2004).

In this contexts, it was considered important to analyse and assess the siosLIFE™ platform, in terms of usability and inclusive nature, so this study could contribute to raise awareness to a set of problems regarding the interface, interaction, content and terminals so this pioneer project could be more successful in its mission of promoting active ageing, contribute for health and wellbeing of the elderly population in nursing homes. The short time and location set made it difficult to gather participants with similar limitations into specific groups, so the study could only gather results from a single, small and heterogeneous group. A complementary approach will be considered to help determine if the results observed would also occur among users presenting no or less severe limitations.

All participants managed to complete the tasks and were very enthusiastic. On the whole, being aged did not hinder their interaction with this technology but it limited their performance, increasing the time to fulfil the tasks. Further research related to active aging through digital devices should be encouraged and carried out, since it can benefit a wide number of people.

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REFERENCES

AGE, 2008. *Older people and Information and Communication Technologies - An Ethical Approach*, AGE, Bruxelles.

Annett, M., Anderson, F., Goertzen, D., Halton, J., Ranson, Q., Bischof, W.F. and Boulanger, P., 2009. Using a multi-touch tabletop for upper extremity motor rehabilitation, *Proceedings of the 21st Annual Conference of the Australian Computer-Human Interaction Special Interest Group on Design: Open 24/7 - OZCHI 09*.

Arch, A., Abou-Zahra, S., Henry, S. L., 2009. Older Users Online: WAI Guidelines Address Older Users Web Experience. User Experience Magazine 8.

Ashok, M. and Jacko, J.A., 2009. Dimensions of user diversity, *The Universal Access Handbook*, Constantine Stephanidis. Boca Raton.

Azevedo, C., 2013. Tecnologias e pessoas mais velhas: As novas tecnologias de informação e comunicação nas relações sociais de seniores em Portugal, *Sociologia da Comunicação e dos Média*, 1171–5.

Blaschke, C.M., Freddolino, P.P. and Mullen, E.E., 2009. Ageing and technology: A review of the research literature. *British Journal of Social Work*.

Cabral, M. V., Ferreira, P. M., Silva, P. A., Jerónimo, P., Marques, T., 2013. *Processos de Envelhecimento em Portugal: Usos do tempo, redes sociais e condições de vida.* Fundação Francisco Manuel dos Santos, Lisboa.

Castells, M., 2002. *A Sociedade em Rede. A Era da Informação*, vol. I, Editora Paz e Terra S/A, Rio de Janeiro.

Chau, F., Soares, C., Fialho, J.A. and Sacadura, M.J., 2012. *O Envelhecimento da População: Dependência, Ativação e Qualidade*, CEPCEP, Lisboa.

Chaumon, B., Michel, C., Tarpin Bernard, F., Croisile, B., 2014. Can ICT improve the quality of life of elderly adults living in residential home care units? From actual impacts to hidden artefacts. Behav. Inf. Technol., 33, 574-590

Czaja, S.J. and Lee, C.C., 2007. The impact of aging on access to technology. *Universal Access in the Information Society*.

Dias, I., 2012. O uso das tecnologias digitais entre os seniores: motivações e interesses, *Sociologia, problemas e práticas*, vol. 68, 51–77.

Dickinson, A. and Gregor, P., 2006. Computer use has no demonstrated impact on the well-being of older adults, *International Journal of Human-Computer Studies*, vol. 64, 744–53.

Farooq, S., Taylor, C.D., Gire, N., Riley, M., Caton, N. and Husain, N., 2015. Digital inclusion: The concept and strategies for people with mental health difficulties, *Australian and New Zealand Journal of Psychiatr*, vol. 49, no. 9, 772–3.

Ferreira, S., 2013. Tecnologias de informação e comunicação e o cidadão sénior: estudo sobre o impacto em variáveis psicossociais e a conceptualização de serviços com e para o cidadão sénior.

Fonseca, I., 2011. O uso de dispositivo multitácteis para a infoinclusão do sénior. Ph.D, Aveiro.

Fozard, J. L., 2001. Gerontechnology and perceptual-motor function: New opportunities for prevention, compensation, and enhancement. *Gerontechnology*, 1**,** 5-24.

Friemel, T.N., 2016. The digital divide has grown old: Determinants of a digital divide among seniors, *New media & society*, vol. 18, no. 2, 313–31.

Gamberini, L., Alcaniz, M., Barresi, G., Fabregat, M., Ibanez, F. and Pront, L., 2006. Cognition, technology and games for the elderly: An introduction to ELDERGAMES Project. *PsychNology Journal*, vol. 4, no. 3, 285–308.

Gamberini, L., Martino, F., Seraglia, B., Spagnolli, A., Fabregat, M., Ibanez, F., . . . and Andrés, J.M., 2009. Eldergames Project: An innovative Mixed Reality Table-top Solution to Preserve Cognitive Functions in Elderly People, *Paper presented at the HSI '09*.

Gorman, L., McLean, D., 2009. *Media and society into the 21st century*. Wiley-Blackwell, Chichester, UK.

Hamelink, C., 2000. *The Ethics of Cyberspace*. Sage Publications, London.

Hartson, R., Pyla, P., 2012. *The UX Book: Process and Guidelines for Ensuring a Quality User Experience.* Morgan Kaufmann Publishers Inc., San Francisco, CA, USA.

Holzinger, A., 2003. Finger Instead of Mouse: Touch Screens as a Means of Enhancing Universal Access. In N. Carbonell & C. Stephanidis (eds), *Universal Access Theoretical Perspectives, Practice, and Experience*, Springer, Berlin, Heidelberg.

INE, 2015. Inquérito a Utilização de Tecnologias da Informação e da Comunicação pelas Famílias, *Instituto Nacional de Estatística*.

Keränen, N. S., Kangas, M., Immonen, M., Similä, H., Enwald, H., Korpelainen, R., Jämsä, T., 2017. Use of Information and Communication Technologies Among Older People With and Without Frailty: A Population-Based Survey. *Journal of Medical Internet Research*, 19.

Lima, M.P., 2004. Envelhecimento e perdas: como posso não me perder?, *Psychologica*, vol. 35, pp. 133–45.

Lowgren, J., 2008. Interaction design. In: A. Zahirovic, J. Lowgren, J. M. Carroll And M. Hassenzahl. *Encyclopedia of human-computer interaction*. The Interaction-Design.org Foundation.

Motti, L., Nadine, V., Gorce, P., 2014. Interaction techniques for older adults using touchscreen devices: a literature review from 2000 to 2013. *J. d'Interaction Pers. me*, 3.

Nazareth, J. M., 2009. *Crescer e envelhecer: Constrangimentos e oportunidades do envelhecimento demográfico*. Editorial Presença, Lisboa

Paúl, C., 2005. Envelhecimento ativo e redes de suporte social. *Sociologia*, vol. 15, 275–87.

Pfeil, U., Zaphiris, P., Wilson, S., 2009. Online social support for older people: characteristics and dynamics of social support. In: *Proceedings of Workshop Enhancing interaction spaces by social media for the elderly.*

Quivy, R. and Campenhoudt, L., 2008. *Manual de investigação em ciências sociais*. Gradiva, Lisboa, Portugal.

Rocha, A.P., 2007. Os autoconceitos dos idosos, Universidade de Lisboa.

Rogers, A., 2004. *Looking again at non-formal and informal education - towards a new paradigm*.

ScaleUpPorto, 2016. Sioslife - Desafios Porto 2016 | Scaleup Porto. *Scaleup Porto.* http://scaleupporto.pt/sioslife-desafios-porto-2016/.

Sociable, 2014. *Sociable - The way cognitive training should be!*

World Health Organization, 2015. *World Report on Ageing and Health*, *World Health Organisation World report on Ageing and Health.*

World Health Organization., 2002. *Definition of an older or elderly person.*

Wu, Y., Ware, C., Damnée, S., Kerhervé, H. and Rigaud, A., 2015. Bridging the digital divide in older adults: a study from an initiative to inform older adults about new technologies. *Clinical Interventions in Aging*, 193-201.

Zaccarelli, C., Passuti, S., Cirillo, G. and Barban, F., 2013. Computer-based cognitive intervention for dementia -

Sociable: motivating plataform for elderly networking, mental reinforcement 30 and social interaction. *Paper presented at the 7th International Conference on Pervasive Computing Technologies for Healthcare and Workshops*.