Willingness and performance of older adults using Information and Communication Technologies for cognitive activity and social interaction

Maria Dolores Castro-Rojas PhD[a,*]

[a]Programme in Human Centered Communication and Informatics, e-LearningLab, Center for User Driven Innovation, Learning and Design, Center for Developmental & Applied Psychological Science (CeDAPS), Department of Communication and Psychology, Aalborg University, 9000 Aalborg, Denmark; *Corresponding author: mariacastro@hum.aau.dk

M.D. Castro-Rojas. Willingness and performance of older adults using Information and Communication Technologies for cognitive activity and social interaction. Gerontechnology 2018;17(3):160-173; https://doi.org/10.4017/gt.2018.17.3.004.00 This study is part of a project aimed at designing a learning intervention to enable older Costa Ricans to use Information and Communication Technologies (ICT) for enhancing cognitive activity and social interaction. This paper presents some results of the designed learning intervention related to participants´ willingness to include the proposed activities with ICT in their daily routines, adequateness of ICT applications to support older adults´ ICT use for cognitive activity and social interaction, and participants' performance in the designed cognitive and social activities. The learning intervention focused on stimulating autobiographical memory (ABM) and training cognitive abilities such as attention, flexibility, problem solving and memory while having social interaction with peers. Forty-one older adults used online social platforms for sharing personal reminiscences and played online cognitive games to train cognitive abilities. Results showed that participants were willing and able to accomplish the cognitive activities freely and independently during the learning intervention period and beyond that period. Content analysis indicated that most of the shared reminiscences were specific personal memories from participants' childhood, which accomplished the social function of reminiscence by creating empathy and social cohesion among participants. Participants improved performance in online cognitive games by repetitive practice. In a linear mixed effect model analysis, the number of times played had a statistically significant effect on performance improvement, whereas factors such as age, education, and positive attitude towards technology did not. Results suggested that this type of intervention can be beneficial for older adults from several cultural and socioeconomic backgrounds and a potential avenue for cost effective interventions aimed to reduce the risks of cognitive impairment and social isolation.

Keywords: older adults, Information Communication Technologies, cognitive training, social interaction, successful aging, active aging

Introduction

This paper is part of a research project aimed at designing suitable learning interventions to enable older Costa Ricans learning about and using ICT for cognitive activity and social interaction. By implementing a Design-Based Research (DBR) approach, the project included older adults and their educators´ perspectives into the design of a learning intervention using ICT (i.e. computers, laptops, mobile devices and applications) to (1) stimulate autobiographical memory (ABM); (2) facilitate cognitive training; and (3) generate social interaction around such cognitive activities. Similarly, the learning intervention sought to promote independence and autonomy of older people when using ICT in their daily life. Two previous articles[1,2] detail the design and implementation processes of the learning intervention.

This paper reports some results of the learning intervention by exploring (a) participants´ willingness to include the activities in their daily routines, (b) adequateness of ICT applications to support older adults´ ICT use for cognitive activity and social interaction, and (c) participants' performance in the designed cognitive and social activities. The general research project focused on facilitating cognitive activity and social interaction, as both are determinants for successful and active aging[3,4], and it has been suggested that ICT can support both aspects by facilitating ICT-mediated cognitive stimulation and training and social interaction[5-8].

In this regard, training healthy older adults using ICT devices and applications, especially cognitive games and video games, can enhance cog-

nitive abilities measured by cognitive tests or tasks[9-15]. In general, the referred studies have shown positive results on performance in the target cognitive tasks. Regarding the transfer of the improvements, Smith et al. (2009) and Anguera et al. (2013) found that the training led to enhanced cognitive performance on untrained tasks, while Ballesteros et al. (2014; 2015) and Nouchi et al. (2012) did not found transfer effects. The studies also differ on the duration of the effects; Anguera et al. (2013) found that performance gains remained stable 6 months after training without booster sessions, while Ballesteros (2015) found that previous significant improvements become non-significant after the 3-month interval.

Considering collectively the results from studies of neuroplasticity and the results from the referred studies, it appears that ICT-mediated cognitive training programs may be effective at countering some age-related cognitive decline. Nevertheless, further research is needed to explore whether performance gains are maintained over time, the underlying mechanisms of action contributing to improvements, the transfer effect to other non-trained cognitive abilities and to activities in older people´s daily life. Although the evidence is not conclusive yet, it is promising enough and supports the efforts to facilitate older people's enjoyment of the confirmed benefits of this type of intervention on cognitive trained tasks and wellbeing and expose them to the potential benefits. In addition, ICT tools have the potential for facilitating lifelong learning process by providing flexible learning models combining self-managed and organized education and providing the additional time that many older people need for personal processing and reflection[5,16].

ICT can also facilitate interacting with family and friends and with wider social networks beyond geographical proximity. Thereby, older people can be part of online communities where they can share interests and achieve developmental goals such as learning for personal development[5,8]. ICT-mediated communication can facilitate social interaction, especially when time for regular face-to-face meetings is lacking. Entertainment technology can also have positive effects in collaborative and pro-social behavior and help stimulate intergenerational relationships[17]. In this regard, Sayago et al. (2011) identified three key elements for older adults using ICT: socialization, inclusion (using the same technologies as the most important members of their social circles), and independence (using ICT not relying on anyone else).

Despite the potential of ICT to improve quality of life during old age by facilitating learning processes, cognitive stimulation and training, and social interaction, older adults often do not use ICT tools. By 2016, just 45% of people aged 65 to 74 living in the 28 countries of the European Union were using the internet frequently (every day or almost every day)[18]. In 2011 in Costa Rica, just 14% of people in that group were using the Internet[19].

As in international contexts one of the main barriers to Costa Rican older adults using ICT is resistance to learning about and using them because of inappropriate learning experiences, for example, older learners perceive that young teachers do not understand their learning process and needs[9,10,26]. This suggests the need for suitable ICT-learning opportunities aimed at fulfilling older learners' needs and interests and including activities that are readily accessible, affordable, and enjoyable for older adults[5-7,20-22].

Although some randomized control trials can be performed in older people´s home and allow them independent and autonomous experiences with ICT[23] the mentioned studies on ICT and cognitive training are based on laboratory experiments and randomized controlled trials whose design limited the opportunities for older adults to learn about and use ICT for enhancing cognitive activity and social interaction independently and autonomously. This leaves a need for enhancing the design of interventions to enable older people using ICT for enhancing cognitive activity and social interaction in their everyday environments. Based on this need and the potential of ICT for supporting successful and active aging the research project, along with selected older people and their teachers, designed and implemented a learning intervention aimed at facilitating the use of ICT by older adults without cognitive impairment for enhancement of cognitive activity and social interaction.

Specifically, for stimulating autobiographical memory, the project implemented some activities from Salazar-Villanea´s, (2010) reminiscence protocol adapted and validated for Costa Rican older people. In these activities the participants used online social platforms to share and comment on memories from their personal past with their peers. For training cognitive tasks, participants had access to LUMOSITY® (www.lumosity.com) - a commercially available online platform that offers cognitive games designed to train attention, flexibility, problem-solving, memory, and processing speed abilities. The intervention occurred in real educational settings and promoted the inclusion of the learned skills on older adults' daily life environments.

This article details some results of the designed learning intervention regarding older adults´ performance on the reminiscence activities, the

Week 1	Session 1	Session 2	Session 3
Week 2	Online Week		
Week 3	Session 4	Session 5	Session 6
Week 4	Online week		
Week 5	Session 7	Session 8	Session 9
Week 6	Online week		

Figure 1 Learning intervention´s organization.

cognitive training and the social interaction surrounding those activities. It also shows some results related to older people´s independence and autonomy when using ICT for cognitive activity and social interaction and presents a brief discussion on the potential of this type of intervention for promoting successful and active aging.

Material and Methods

General design

Implementing a Design Based Research (DBR) approach the general research project, in collaboration with older adults and their educators, designed and implemented a learning intervention to facilitate older adults without cognitive impairment using ICT for enhancing cognitive activity and social interaction[1,2]. It was a six-week learning intervention that included classroom (face-to-face) and online activities.

During the six-week period, older people, organized into four groups of 10 learners each, participated in three classrooms´ activities weeks and three online weeks, each classroom week was followed by an online week. During a classroom week, participants attended three learning sessions, each of two and a half hours long. During an online week, participants completed at least two assignments at their convenience and published their results and reflections on online platforms. The classroom sessions were implemented in the computer labs of the Omar Dengo Foundation (FOD), a Non-Governmental Organization working with education and ICT in Costa Rica www.fod.ac.cr.

Figure 1 shows the organization of the learning intervention for all the four groups. The research project was approved and conducted in agreement with the guidelines of the Costa Rican Institute of Clinical Research and the Health Ministry. All the participants gave their written consent before the study started.

Participants

The study recruited the participants through a general call in governmental and non-governmental organizations working with older adults' education. The inclusion criteria of the study were: (1) being older than 60 years; (2) being able to write and read; (3) having little experience using ICT devices and applications; (4) having no psychiatric, neurological, or neuropsychological disorders clinically provable; and (5) having a score of 25 points or above on the MMSE (for non-literate individuals, a score of 19 points could be accepted). Potential participants who met the inclusion criteria participated in the study.

Forty-one people (33 females) older than 60 years (M=67.10, SD=5.40), who had no cognitive impairment measured by the Minimental State Examination (MMSE) M=28.61, SD=1.48 participated in the learning intervention. The participants were randomly assigned to one of four learning groups of approximately 10 participants each (*Table 1*).

Regarding access and use of ICT, 78% of the participants had used the computer during the three months prior to the initial interview, 85.4% had used the internet, all of them had used mobile phones and 82,9% had a smartphone for personal use. Fourteen participants (34.1%) had used the internet more than 5 hours during the week prior to the initial interview, 17.1% reported internet use for 4 to 5 hours, 29.3% used the internet between 1 to 3 hours, while 19.5% did not use the internet during that period.

The most commonly used ICT were mobile devices (tablets and smartphones) and the internet. The most performed activities were related to social interaction and leisure, while the least frequently performed were learning, social participation, and instrumental activities[2]. Although the majority of participants had experience as computer and/ or Internet users they relied on only basic fea-

Table 1. Demographics of participants

Characteristic	Category	% (N=41)
Age group	60 -64	34.2
	65- 69	34.2
	70-74	26.8
	75-79	2.4
	80 and above	2.4
Marital status	Married /civil union	58.5
	Separated /divorced	17.1
	Widowed	12.2
	Single/never married	12.2
Education level	Some / completed primary school	17
	Some / completed high school	41.5
	Some / completed university	41.5
Community	Rural	4.9
	Urban	95.1

tures of ICT devices and applications, were non-independent users and presented important gaps in basic ICT literacy[24], which the present study characterizes as having little experience using ICT devices and applications.

Therefore, according to the Information and Communication Technology Social Networking Motivational model proposed for older adults by Vroman et al. (2015), the participants were in the first level of ICT adoption, which means that they used ICT mainly to support personal relationships and for social networking with family and friends. Even into this first level, participants relied on only basic features of ICT, and as non-independent users, they experienced limitations on when and how to use ICT. In sum, they had a basic and limited use of ICT devices and applications. The next level of the model is using ICT for practical tasks; this could involve accessing information and carrying out daily instrumental tasks. The final level is the least personally intimate network; here, ICT is a link to broader communities, within and outside the person's geographical location.

Methods

Initial questionnaire and surveys

Prior to the learning intervention, the participants answered one questionnaire that included questions about socio-demographics and access to, and experiences with technologies. Participants also completed the Survey of Technology Use (SOTU) a component the Matching Person and Technology Model (MPT)[34]. It is a 29-item survey designed to examine an individual's predispositions to technology through his/her attitudes and experiences, a higher score in the positive subscale indicates a more positive attitude. The SOTU has shown to be valid across cultures when measuring attitude towards technology[8]. Participants also completed the MMSE as screening for cognitive impairment.

Reminiscence intervention

During the learning intervention, the participants accomplished two activities of a reminiscence protocol adapted for older Costa Ricans[26]. As the combination of written and oral reminiscence seems to be more effective than general reminiscence for older people without cognitive impairment[27], the project implemented a combination of Salazar-Villanea's (2010) reminiscence protocol and a guided autobiography reminiscence´s technique[27] in order to stimulate private reflection and group interaction. This included private writing and posting the personal memories, and sharing and commenting them in online platforms and in the classroom.

After learning the basics for using computers, laptops, smartphones and tablets and ICT-applications such as e-mail, Moodle®, Facebook®, Blogger®, and Skype® two of the learning groups (1 and 2) used Facebook to share two personal memories: one about leisure and free time, and the other about school time and training. The other two groups (3 and 4) shared their memories by creating a blog in Blogger. The aim of using two platforms was to compare the characteristics of the stories and the social interaction in each one.

Participants had to read and comment on their peers´ stories and help each other to achieve as detailed a memory as possible. Participants shared one story in small groups in the classroom for modeling the type of feedback required. All posts and comments were recorded for analysis.

Online cognitive games

After the reminiscence intervention, the next online week participants had access to Lumosity. In order to promote participants´ independence and autonomy when using ICT they received instructions by email for exploring the platform at their daily life environments. Then at the next face-to-face session the facilitators formally introduced the platform and answered participants´ questions about access and usability.

During the learning intervention, (March to May 2016) participants were asked to complete, in their daily environments, a minimum of two training sessions (five cognitive games each) a week. However, they could train as much as they wanted. After that period, participants had access to Lumosity until January 2017, and they trained, as they wanted.

In addition, during the intervention, participants from groups 1 and 2 shared their experiences with cognitive training on Facebook, and participants from groups 3 and 4 shared their reflections through Blogger. Each participant had a user ID in Lumosity, and all training sessions were recorded for analysis, data on online social platforms was also recorded. Participants used their computers and mobile devices for reminiscence activities and cognitive training.

Data analysis

Questionnaire and survey

Using the Statistical Package for Social Sciences SPSS 22 descriptive statistics were calculated from the questionnaire and the SOTU to describe the patterns of ICT access and usage and attitudes towards technology among participants[10].

Reminiscence activities

Reminiscences (personal memories) were analyzed by classic content analysis[28], using the analytical category system proposed by Salazar-Villanea (2010) which includes three main categories: structural characteristics of the narration, narra-

Table 2. Personal memories, topics, and platforms

Topic	# of memories	Including a previous stage of handwriting/typing	Blogs	Facebook	Just handwritten or typed
Leisure and free time	46	6	11	13	22
School time and training	19	6	8	7	4
Not defined	1	0	1	0	0
Total memories	66	12	20	20	26

tive characteristics according to the proposed topics, and type of memory. Each story was a unit of analysis. All the stories were coded using NVIVO 11 software. Tables in the results section reflect the general categories, subcategories, and frequencies of codes. Finally, the meanings and relationships between the categories and subcategories were analyzed and some excerpts are presented to illustrate those meanings.

Performance in online cognitive games

Performance in cognitive games was measured for each user for each game by the normalized score on the Lumosity Performance Index (LPI), which is assumed to be comparable across users and games. We used the difference between the first LPI score and the last LPI score as a measure of performance improvement (LPI improvement = LPI end - LPI start) for each user in each game.

The LPI improvement was modelled by a linear mixed effects model with random effects of game and user and fixed effects of number of times played, age, education, and positive attitude toward technology (measured by the SOTU). The random effect of the user can be interpreted as a user level, some users are good at playing games and some are not as good. The interpretation of the random game effect is similar; some games are difficult and some are easy. The analysis used the lme4 package[29] and the pbkrtest package[30] in the statistical software R and the REML approach for unbalanced data.

To test the effect of the fixed effects, (number of times played, age, education, and positive attitude toward technology) each effect was added in turn, and the effect was tested for being 0 by an F-test with the Kenward-Roger approximation. We also tested if the fixed effect of number of times played was significant when the fixed effect of age, sex, education, and positive attitude toward technology was already in the model.

Comments and posts on online social platforms about reminiscence and online cognitive games experiences

Comments about reminiscence and cognitive games were analyzed by an inductive content analysis[31]. Following Mayring (2000), all the data were read to extract common topics, and a set of analytical categories was defined[41]. After 10% of the material had been reviewed, the codes and categories were revised, and this was done again after 60% of the material had been reviewed. At both intervals, some categories were subsumed and new ones were created. The final analytical categories and the codes´ system are reflected in the tables in the results section. All the data on online social platforms were coded using NVIVO 11 software.

Results

Results from the reminiscence intervention

Reminiscences and online social platforms

Thirty-two out of 41 participants shared their memories. Nine participants did not share reminiscence stories but were active in face-to-face sessions and commenting their peers' personal memories. The 32 participants shared 2.06 stories on average as some of them spontaneously shared more stories. Some participants implemented a first stage of handwriting and/or typing before sharing their stories online, and some of them just shared their stories in handwritten or typed format. *Table 2* presents details about stories, topics, and platforms.

The first topic about leisure and free time elicited 46 stories, and participants shared most of their stories (22) in handwritten and typewritten format, which were collected for analysis. Some of these stories (6) were shared later online. As one of the main goals of the learning intervention was adapting the need to respect their transitions when using ICT, the intervention respected older adults' preference on the format for presenting their personal memories.

For the second topic, there were 19 personal memories and fewer stories (4) remained in traditional formats, which could indicate that participants became more comfortable sharing their memories online. Two participants shared personal memories non-related to the required topics.

There were no major differences by platform in the number of stories and resources (text, pictures, and videos) used for sharing them. However, the participants using Facebook (groups 1 and 2) posted more comments than those using Blogger (groups 3 and 4). *Table 3* shows the details.

Most of the participants shared their memories using only text and just a third of the stories in-

Table 3. Resources and comments by platforms

Platform	Stories presented by text	Stories presented by Text and pictures/videos	Social comments	Content comments	Total comments
Blogs*	13	7	33	7	40
Facebook	13	7	56	22	78

*This include the memory shared non-related to the requested topics

cluded pictures and/or videos. It could be that only more experienced users were able and willing to use these resources and that more time and practice is needed for participants using multimedia resources. This points out the need for considering different learning needs and levels when designing ICT interventions for older people and the need of respect their transitions in the path of becoming efficient ICT-users[5,6,8].

Comments on personal memories were almost twice frequent in Facebook than in Blogger. It might be that Facebook generated more participation because it offers more synchronic interaction and direct access via the app on mobile phones than Blogger. In both platforms, there were more social comments (for example, thanks for sharing and praising the stories) than comments asking for more completeness in the story. The prevalence of social content aligns with the first phase of the "community-centered socio-ecological model" proposed by Vroman et al., (2015) where older adults use ICT for social networking.

Characteristics and functions of reminiscences

Sixty-six stories from both topics were analyzed, 40 shared online and 26 collected in handwritten and typewritten format. *Table 4* presents the frequencies of the main analytical categories and subcategories previously validated for older Costa Ricans[26].

Table 4. Characteristics and functions of reminiscences

Structural characteristics of the narration	Number of stories
Narrative coherence and order	
Narrative disorganized and confused	1
Narrative with significant lack of chronology or completeness	13
Narrative with a chronology sense and some details	24
Narrative follows a chronological order and offers a complete overview of the events	26
NA	2
Total	**66**
Narrative characteristics according to the proposed topic	
Temporal distribution	
Childhood (0-11 years)	32
Adolescence (11-17 years)	5
Adulthood (18-60 years)	13
Old age (60 and more)	9
NA	7
Emotional valence	
Neutral	3
Positive	48
Negative	11
NA	4
Reminiscence´s function	
Interpersonal / Social	66
Intrapersonal	7
Cognitive	0
Type of memory	
Episodic memory	40
Semantic memory	26

One memory was difficult to follow because there were few details. Thirteen stories lacked chronology or completeness; that is, an important element of the story was missing, or the story had no order. However, most of the stories showed a coherent and ordered narrative; twenty-four stories presented a general order of the events, but with some omissions in chronology and/or missing details. For example:

"I*t was my 15th birthday […] it was a surprise when I came home back from high school my mom had cut the flowers from the garden and put them on a large table, there were some food and drinks to celebrating my birthday*" (Leisure and free time, woman, 73)

There it is possible to know when the events happened, but details about the sequence of the events are missing. On the other hand, twenty-six stories presented a clear chronological order, a complete overview of the events, and many details:

"*The teacher organized a school trip for vacations […] my sister went with me; we took the bus to the school. There were Marcela, Leda, Sonia […] at the school, all classmates and companions took another bus and finally, we arrived at the farm, there were many trees such as orange, mango […]. We took as many fruits as we wanted. Then it was time to go to the dairy place…*" (Leisure and free time, woman, 67)

Excluding two exceptions, all the stories echoed the proposed topics. One participant shared some reflections on how alcohol abuse affected his leisure and free time, and another participant victim of child sexual abuse found it very disturbing to recall memories from her past, then shared life events without order.

Almost half of the memories (31) were about childhood, which aligns with the evidence that long-term memory is better conserved during the "normal" aging process[32,33] and for seven stories, it was not possible to identify the referred life period. Regarding emotional valence, most of the stories (48) expressed positive emotions:

"*We were happy going to the break at school; we went to a small shop inside the school to buy something to eat […] before going home we used to go to a small candy shop in the city, they sold colorful lollipops, they were delicious […] the train was yellow really beautiful. I feel happy remembering this time*" (School time and training, woman,75)

Negative emotions referred to embarrassment, anger, and nostalgia for the past. In four stories, it was not possible to identify related emotions. Considering that narrating reminiscences is a positive activity that can be effective in improving wellbeing, alleviating and preventing depression[34,35], the majority of positive emotions experienced by the participants when reminiscing might indicate that reminiscence supported general wellbeing and social interaction among them.

Concerning the functions of reminiscence, all the shared stories aimed to share information and/or values with others or to tell stories for entertainment. Thus, accomplished the social/interpersonal function of reminiscing, which is to interact socially and exchange experiences, thereby creating empathy by understanding and interpreting similar experiences from others[35]. In this function, reminiscence is primarily descriptive, so there is little interpretation or evaluation of the events or emotions[36].

"*Now sharing this memory with you, I'm so happy because this was one of my first's academic achievements*" (School time and training, woman, 60)

Although the three of reminiscence proposed in the analytical category system have discrete labels, the same memory can serve different functions. Therefore, four stories besides the social function, recounted significant relationships in order to affirm affective bonds[36]:

"*It is nice to be with my friends, we have been friends for about 30 years, and we love each other very much. It is a support group; we are together through good times and bad*" (Leisure and free time, woman, 69)

In addition, seven stories also accomplished the intrapersonal function aimed to the resignification of events for creating a sense of resolution and/or to reflect on the self:

"*This event was devastating, my education was truncated, and I got an enormous fear to be rejected by society and women. I thought that nobody would love me. Thank God that was not the end of my life story*" (School time and training, man, 72)

No stories indicated the cognitive function of reminiscence, related to the role of ABM in solving problems and guiding one´s behavior and allowing individuals to ask new questions about old information to solve problems in the present or to predict new events[37].

Regarding the type of memory, 40 stories were episodic memories, that is, events that occurred in a given time and place, in less than one day, and included details about the context as well as sensory and emotional information. They showed knowledge of specific and individual events that could occur in hours and minutes:

"*It was 63 years ago; January 15th, 1953. We (my parents, three sisters, three brothers, and I) went to the local festivities…*" (Leisure and free time, man, 69)

On the other hand, 26 stories were semantic memories or abstract memories of events that occurred repeatedly or in several days. These memories identified events, but did not report a specific episode.

In summary, most of the participants autonomously and independently recalled personal memories in their everyday environments and share them in different formats. Most of the participants stimulated ABM in their daily environments, which is a positive activity that can be useful for cognitive stimulation and for improving wellbeing and alleviating depression[34,35,38]. By the availability of different formats and openness to participants´ preferences, the learning intervention seem to have supported the transition of some participants from traditional formats to sharing online, but it also supported general participation by adapting to participants´ needs and preferences.

Both Facebook and Blogger presented similar numbers and types of stories and used for sharing, and both seemed to be adequate for sharing reminis-

cences. However, Facebook presented more comments and therefore more social interaction. Most of the memories presented a coherent and organized structure, were about childhood, reflected a positive emotional valence, and accomplished the social/interpersonal function of stimulating social interaction, bonding, and intimacy and promoted positive feelings in the participants[35]. The majority of the stories was episodic memories, which indicates that participants made efforts to recall detailed memories and thus stimulated ABM, worked with memories that are valuable for the self and served mainly social and cultural functions.

Results from online cognitive games

Players and games

After the reminiscence intervention, the participants had access to Lumosity a web-based game application for training cognitive abilities. The project selected Lumosity, as it is a commercially available which means that interested older people can access it easily from their daily life environments and because it combines cognitive training and leisure/entertainment activities which is an important factor for engaging older people in using ICT[5-7].

Three of the 41 participants left the learning intervention before starting the online games due to personal reasons. Then, 33 out of the 38 participants played the cognitive games, five active participants never played; two of these participants also did not share their personal memories, but stayed active in the face-to-face sessions and in some other online activities. There were 27 female and 6 male players between 60 and 87 years old (M=67.54, SD=5.61). Six of them (18.18%) had some or completed primary school education, 12 (36.37%) had some or completed high school, and 15 (45.45%) had some or completed university. *Table 5* shows players by periods from March 2016 to January 2017.

All the participants in this phase played during the intervention period (March – May 2016) and a significant fraction played beyond that period. Although the number of players decreased over time, it is remarkable that one third of them kept playing independently for almost a year after the intervention. During the intervention period, the participants using their own ICT devices (computers, tablets and smartphones) included cognitive training in their daily routines and shared about their experience on Facebook and Blogger. However, the researcher and facilitator were available in the face-to-face sessions and by phone, email or Facebook to help the participants when they needed it. After the intervention, participants did not have any contact with the researcher or facilitator, so they played independently and autonomously.

Table 5. Players by periods from March 2016 to January 2017

Period	# Players
March –May 2016	33
June – August 2016	22
September – November 2016	14
December 2016 – January 2017	11

Difficulties reported exploring the cognitive games platform

In order to promote participants´ independence and autonomy when using ICT they were asked to explore Lumosity at their daily environments during an online week. They received their user ID and instructions by email, and explored, played and solved issues by themselves for a week. The next face-to-face session the researcher introduced the platform and its features and solved the issues reported by the participants.

The main issues reported by the participants exploring the platform included:

(1) Problems typing credentials: some participants could not access the platform because of typing mistakes. Because the platform did not offer an option to visualize the password, players could not identify their mistakes.

(2) Problems reading and following instructions: most of the participants omitted reading the games´ instructions and started playing. Most of them did not identify when and how the platform offered the instructions.

(3) Problems finding the help function: once participants realized they did not know how to play the games, they did not find the help resources. Most of the participants did not identify the question mark icon as an indication of help.

Before the clarifying session, participants helped each other to get on to the platform and understand the games. After formal clarification, they played independently and asked for help from their peers and/or the facilitator for specific issues. The exploratory behavior and participants' efforts in helping each other during the exploring time indicated interest in and willingness for using new technological resources. The reported difficulties reflect that some platform´s features need to be adjusted for older users and those older adults need formal instruction to become independent users. Only observations recorded after the formal training on Lumosity´s use were included in the analysis.

Games´ results

It is well known that performance on cognitive tasks improve with practice. Thus, we explored if improvements could be confirmed in the present sample and which additional factors were related to performance improvements in online cogni-

Table 6. Analysis of fixed effects on performance improvement

Variables	*F*	*df*	*p*
Number of times played	37.03	1.726	< 0.0001
Age	1.73	1.31	0.1977
Education	1.76	1.30	0.1943
Positive attitude towards technology	0.68	1.33	0.4167

The numbers are tests of the model with just the random effects (user and game) against the larger model with also the fixed effect mentioned at the corresponding rows

tive games. First, we clustered the observations within individuals and games and obtained 766 observations. Then, in addition to the normalized score (LPI), we included factors such as number of times played (number of times that one individual played one specific game), age in years, education (primary school, high school, and university), and positive attitude toward technology.

We included all the records from May 2016 to January 2017 in a linear mixed effects model with random effects of game and user. Then each of the fixed effects (the number of times played, age, education, and positive attitude toward technology) was added separately in turn to the model with only random effects. The only fixed effect with an effect significantly different from 0 was the number of times played ($p < 0.001$). *Table 6* shows the results of this analysis.

The analysis showed that just number of times played had a statistically significant effect on performance improvements. Then using the Kenward-Roger approximation for degrees of freedom, we included number of times played while controlling for age, education, and positive attitude toward technology. Only number of times played had a significant effect on performance improvement F (1-725)= 36.68, p<.001.

The fixed effect of the number of times played was 0.41. This means that for an increase of one in number of times played, the mean increase in LPI improvement is 0.41 points. The standard deviation (SD) of number of times played was 136, so an increase in number of times of one SD results in a mean increase in LPI improvement of 55.6 points. This can be observed in *Table 7*.

Table 7. Means of number of times played and performance improvement by quartile

Quartile	Mean number of times played	Mean LPI improvement
1	2.33	45.83
2	6.40	131.87
3	20.65	219.58
4	116.13	599.26

It can be concluded that participants learned how to solve the cognitive tasks regardless of their age, education level and attitude towards technology. The results on performance improvements seem to align with previous research findings with healthy older adults which have found that improvements in the performance on online cognitive games are related to positive effects in the trained cognitive skills measured by cognitive tasks different from those presented in the online games[10-14]. This initial improvement on the practiced tasks must be contrasted to external measures of cognition and control groups to conclude about the efficacy and benefits of cognitive training.

Overall, participants included the cognitive training in their daily life and trained independently and autonomously during the intervention period and one third of them during the next eight months after that period. Even though participants had some difficulties using the platform without formal training, after formal instruction, they became independent and efficient users. The results evidence the potential of this type of intervention for (1) engaging older adults in learning about and using ICT independently for enhancing cognitive activity; (2) exposing older adults to the confirmed and potential benefits of cognitive training, and (3) offering suitable interventions for older adults from different socio-economic backgrounds.

Reflections on cognitive games and social interaction

To stimulate metacognitive processes, participants were asked to keep a record of their thoughts during the first five days of training and shared a general opinion of the cognitive training by Facebook (group 1 and 2) or Blogger (3 and 4). Their posts had to include the number of days they played, the easiest and most difficult tasks, favorite games, any strategy for improving performance, and general emotions before and after training. They had also to read and comment on other participants' posts.

Ten participants shared their experiences via 27 Facebook´s posts, and 10 participants via 16 blog posts. *Table 8* shows details of the content of participants' posts on both platforms. A majority of the posts referenced the positive aspects of the cognitive training, including that games were funny and enjoyable, participants felt good during the training, observed positive changes in their performance and experienced less stress when playing over time. The majority of posts also de-

Table 8. Content of posts about cognitive training

Platform	Positive aspects	Difficulties	Easy and difficult games	Practical information	Preferences	Strengths and weaknesses	Strategies
Blogger	29	6	9	10	3	8	11
Facebook	31	4	8	9	3	10	3

scribed the training positively in terms of potential benefits on cognitive abilities and personal achievement. Posts about difficulties referred to problems understanding and following instructions and getting low scores. Practical information reported problems with credentials, internet access, and environmental conditions, e.g.: noise. Participants reported personal characteristics (e.g. anxious or patient) as weaknesses or strengths, and based on Lumosity´s reports, they shared their best and worst performed cognitive tasks. Participants also reported general strategies to improve their performance, for example, reading instructions carefully and relaxing before training. However, they did not share specific strategies for improvement. This might indicate the need for better activities to facilitate participants' recognition of specific strategies to solve the games' tasks and transfer these strategies to cognitive tasks in their daily environments.

Participants also commented and interacted on their peers' posts. Most of the comments had social content and served for social networking. *Table 9* presents details of participants' comments on the posts on cognitive training in Facebook and Blogger. Participants posted their impressions in blogs through main posts, and their peers´ comments were mostly social comments (thanking for sharing or praising the post) and offered social support (encouraging each other to keep training). Participants using Facebook shared their impressions through main posts, and some of them did as comments to their peers´ posts. Therefore, the feedback was more dynamic and less structured on Facebook than in Blogger.

Discussion

In order to contribute to overcoming barriers to ICT-based interventions suitable for older adults, the research project designed a learning intervention that enabled older adults to use ICT independently and autonomously for enhancing cognitive activity and social interaction. The participants in a blended learning environment used ICT devices and applications for reminiscence activities and online cognitive training. At the same time, they shared their experiences and results in the cognitive activities on online social platforms.

The results from the implemented activities indicated that participants were willing and able to include ICT for reminiscing, cognitive training and social interaction in their daily life independently and autonomously. The blended learning environment allowed participants applying the learned skills in their daily life, a need noted by several authors[6-8,39]. Practicing outside the classroom allowed participants to control such aspects as location, schedule, and length of the practice. They also had sufficient flexibility to combine learning activities with daily life activities. Finally, using their own mobile devices allowed mobility and facilitated appropriation of participants' own ICT tools.

Working with reminiscence facilitated participants' communication of their own life knowledge and experiences and allowed them to share mutual and individual experiences framed in a common historical period. Furthermore, as all the shared memories accomplished the social/interpersonal function of reminiscing, sharing personal reminiscences stimulated social interaction, bonding, and intimacy. Similarly, as shown by the number of references to positive emotional valence these activities promoted positive feelings in the participants[27,35,36] and generated a positive learning environment. In addition, reminiscing exposed the participants to potential benefits of reminiscence activities such as stimulating language functions; promoting openness to personal relationships; supporting identity, self-esteem, and continuity; and validating personal knowledge[34,38,40]. Nevertheless, future research must evaluate these benefits.

As none of the personal memories accomplished the cognitive function of reminiscence, which is using information from experiences to solve problems, guide one´s behavior and predict new events[36,37] it might be needed more mediation and guide from facilitators for accomplishing these functions. Further research might work on designing learning activities aiming at this goal.

Table 9. Comments on cognitive training posts

Platform	Social	Social support	Positive Aspects	Difficulties	Easy and difficult games	Practical information	Strategies	Total comments
Blogger	22	7						39
Facebook	36	11	12	3	3	15	1	81

Even though the intervention aimed to elicit positive functions of reminiscence, in two cases sharing personal memories from a particular period of life, provoked bitterness; therefore, it is important that professionals involved in the implementation of this type of interventions can properly manage these situations to maintain participants' wellbeing and stimulate positive functions of reminiscence.

Regarding the online social platforms selected for sharing personal memories, both Facebook and Blogger seem to be suitable for older adults to perform this type of activities. However, Facebook presented more comments and social interaction. It could be that synchronic aspects of Facebook facilitated more interaction and/or that participants were more familiar with the social network. Further research might investigate which features of social online platforms are suitable for older adults.

Finally, the reminiscence intervention provided opportunities for both subjective activities, by reflecting on identity and subjectivity, and objective activity by learning about and using ICT. This approach balanced successful and active aging models[3,4,32] and subjective approaches that postulate the importance of development of identity and subjectivity over productive activity[34-36,38]. Therefore, the present study also contributes to the development of tools to promote specific methods or techniques to promote the narrative development of identity based on autobiographical memories[27,36,40].

On the other hand, training cognitive abilities by playing online cognitive games combined learning, training, and leisure activities 5. Therefore, participants found training to be a fun and enjoyable experience. Participants included cognitive training in their daily routines, became independent users, and improved their performance by repetitive practice as showed in previous studies[9-11,13]. However, further research is needed to evaluate the effects of cognitive online games on trained cognitive abilities, transfer to other non-trained abilities as well as their long-term and real-life efficacy. As shown by the posts and comments during the training process participants noted a sense of satisfaction and achievement as well as positive changes during the process (e.g.: from a stressed state when playing to a more relaxed state over time). They additionally noted improvements in their performance.

The analysis found no statistically significant influence of age, education, and positive attitude towards technology on performance improvement. Practice was the most important factor for improvement. This might indicate that this type of intervention can be suitable for older adults from different cultural and socioeconomic backgrounds. Furthermore, these findings could suggest lines of future research on the interaction of cultural and socioeconomic factors and performance improvement in cognitive tasks. Performance improvement indicates that the participants learn strategies to solve several cognitive tasks. However, they did not share specific problem-solving strategies that helped them improving their performance. This might indicate that more mediation is needed to stimulate participants' metacognitive processes to use those strategies for solving similar cognitive tasks in daily life.

The results showed that web-based cognitive games need to adapt some of their features to older users and that current older adults need formal training to take advantage of cognitive training tools and online social platforms. After formal training, practice and repetition older adults became independent and efficient users. Both online social platforms Facebook and Blogger seemed to be adequate for supporting social interaction around cognitive training, but Facebook reflected more interaction. Since participants interacted in the online platforms with almost no mediation, having a mediator or community manager might support more interaction and interventions focused on facilitating metacognitive processes. In this regard, it is important to remark that future studies need to analyze the possible effects of sharing and interacting on online social platforms on performance improvements in cognitive tasks.

Additionally, by implementing the learning intervention in a natural learning setting, including online components, offering opportunities for practicing in daily living environments, and using their own devices, participants gained independence and autonomy when interacting with ICT devices and applications.

Considering the capacity of this type of intervention to involve simultaneously a greater number of older adults in cognitive stimulation and training and social interaction activities, these interventions have enormous potential as community-based and cost-effective means to reduce the risks of cognitive impairment and social isolation. The fact that some older adults already have personal ICT device also supports the viability of these types of psychological interventions. However, some challenges still need to be overcome such as: including older people from different geographic locations, cultural backgrounds and physical and cognitive functioning level in the design and implementation of suitable learning interventions, planning the use of available public ICT infrastructure in Costa Rica to support older adults currently without access to personal ICT devices, and designing community-based learning services for increasing the number of older adults receiving benefits.

Conclusions

As suggested in the literature[5,8], allowing older adults to use different ICT platforms and resources supported their participation regardless of their level of knowledge and familiarity with ICT. This also provided them an environment that was respectful of their needs and interests and allowed their transition from traditional formats of sharing their experiences to sharing on online platforms, which showed that older adults' use of ICT for enhancing cognitive activity and social interaction is a learning continuum. The focus on social interaction, as suggested by previous studies[6,8], also supported a collaborative learning environment.

The results showed that older adults are willing and able to incorporate ICT devices and applications for cognitive activities and social interaction into their daily life. This is relevant considering that few older adults in Costa Rica are using ICT and those identified as active users are using ICT just for social networking with family and friends. Facilitating strategies for learning by doing, repetition and practice, and having multiple opportunities to apply the learned skills in their daily environments were useful approaches for older adults becoming independent and efficient users of the selected ICT devices and applications. The online platforms used were suitable for older adults to perform cognitive activities and social interaction. However, social and cognitive training platforms need to adjust their features to older users, and current older adults need formal instruction in order to manage a platform´s features.

Participants shared episodic memories, exercising different abilities of autobiographical memory and accomplished the social/interpersonal function of reminiscence of promoting social interaction and openness to personal relationships[27,35,36,38]. The most important factor for performance improvement in trained cognitive tasks was practice. Age, education, and attitude towards technology did not have a statistically significant effect on performance improvement, which might indicate that this type of intervention can be beneficial for older adults from different sociocultural backgrounds. It could also be a fun and enjoyable experience.

Since this type of intervention has the potential for including simultaneously several older adults from different sociocultural backgrounds in psychological interventions aimed at preventing the risks of cognitive impairment, dementia, and social isolation, they could be a potential avenue for cost-effective interventions aimed at preventing the negative outcomes of aging in modern societies.

Limitations of the study

Some limitations of this study are that it was based on a small sample and included older adults who were mostly ICT users (basic and non-independent users as stated in the participants' description) and few non-users, all of them interested in learning about and using ICT. This limits the generalization of the research findings to similar learners. The results might have been different for a sample of non-users and/or participants with even less experience using ICT. Also, due to limited resources, the study did not include an inter-rater reliability measure for the coding process. Finally, we did not measure the effects of the implemented cognitive activities on cognitive abilities. Future research should pursue replication in large and more diverse samples, evaluation of the intervention´s effect on cognitive abilities, transfer and long-term effects, and effects on everyday tasks.

Conflicts of interest

I wish to confirm that there are no known conflicts of interest associated with this publication. A research agreement was subscribed with Lumosity package manufacturers to give participants access to the platform. However, the study was conducted independently for them.

Acknowledgements

This project has been funded with support from the European Commission thanks to the Erasmus Mundus Action 2 scholarship project AMIDILA. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use, which may be made of the information contained therein.

References

1. Castro-Rojas, MD., Bygholm, A., Hansen, T.G.B. (2018). Exercising older people´s brains in Costa Rica: Design principles for using information and communication technologies for cognitive activity and social interaction. Educational Gerontology, 44(2-3), 171-185. https://doi.org/10.1080/03601277.2018.1433485
2. Castro-Rojas, MD., Bygholm, A., Hansen, T.G.B. (2016). Using information and communication technologies to promote healthy aging in Costa Rica: Challenges and opportunites. In: Zhou J., Salvendy G. (eds). Human Aspects of IT for the Aged Population. Healthy and Active Aging. ITAP 2016. Lecture Notes in Computer Science, vol 9755, 194-206. Springer, Cham. https://doi.org/10.1007/978-3-319-39949-2_19
3. Rowe, J. W., & Kahn, R. L. (1997). Successful Aging. The Gerontologist, 37(4), 433–440
4. World Health Organization [WHO]. (2002). Active ageing. World Health Organization [WHO]. Retrieved from http://ec.europa.eu/social/main.jsp?catId=1062&langId=en
5. Ala-Mutka, K., Malanowski, N., Punie, Y., & Cabrera, M. (2008). Active Ageing and the Potential of ICT for Learning. Spain: European Commission for Prospective Technological Stdudies. https://doi.

org/ 10.2791/33182
6. Sayago, S., Forbes, P., & Blat, J. (2013). Older People Becoming Successful ICT Learners Over Time: Challenges and Strategies Through an Ethnographical Lens. Educational Gerontology, 39(7), 527–544. https://doi.org/10.1080/03601277.2012.703583
7. Sayago, S., Sloan, D., & Blat, J. (2011). Everyday use of computer-mediated communication tools and its evolution over time: An ethnographical study with older people. Interacting with Computers, 23(5), 543–554. https://doi.org/10.1016/j.intcom.2011.06.001
8. Vroman, K. G., Arthanat, S., & Lysack, C. (2015). " Who over 65 is online?" Older adults' dispositions toward information communication technology. Computers in Human Behavior, 43, 156–166
9. Anguera, J. A., Boccanfuso, J., Rintoul, J. L., Faraji, F., Janowich, J., Kong, E., … Al-Hashimi, O. (2013). Video game training enhances cognitive control in older adults. Nature, 501(7465), 97–101. https://doi.org/10.1038/nature12486
10. Ballesteros, S., Mayas, J., Prieto, A., Barrera, P. T., González, C. P., De León, L. P., … Waterworth, J. A. (2015). A randomized controlled trial of brain training with non-action video games in older adults: Results of the 3-month follow-up. Frontiers in Aging Neuroscience, 7, 45. https://doi.org/10.3389/fnagi.2015.00045
11. Ballesteros, S., Prieto, A., Mayas, J., Toril, P., Pita, C., de León, L. P., … Waterworth, J. (2014). Brain training with non-action video games enhances aspects of cognition in older adults: A randomized controlled trial. Frontiers in Aging Neuroscience, 6, 277. https://doi.org/10.3389/fnagi.2014.00277
12. Nouchi, R., Saito, T., Nouchi, H., & Kawashima, R. (2016). Small Acute Benefits of 4 Weeks Processing Speed Training Games on Processing Speed and Inhibition Performance and Depressive Mood in the Healthy Elderly People: Evidence from a Randomized Control Trial. Frontiers in Aging Neuroscience, 8(December), 302. https://doi.org/10.3389/fnagi.2016.00302
13. Nouchi, R., Taki, Y., Takeuchi, H., Hashizume, H., Akitsuki, Y., Shigemune, Y., … Kawashima, R. (2012). Brain training game improves executive functions and processing speed in the elderly: A randomized controlled trial. PLoS ONE, 7(1), e29676. http://doi.org/10.1371/journal.pone.0029676
14. Rebok, G. W., Ball, K., Guey, L. T., Jones, R. N., Kim, H. Y., King, J. W., … Willis, S. L. (2014). Ten-year effects of the advanced cognitive training for independent and vital elderly cognitive training trial on cognition and everyday functioning in older adults. Journal of the American Geriatrics Society, 62(1), 16–24. https://doi.org/10.1111/jgs.12607
15. van der Wardt, V., Bandelow, S., & Hogervorst, E. (2012). The relationship between cognitive abilities, well-being and use of new technologies in older people. Gerontechnology, 10(4), 187–207. https://doi.org/10.4017/gt.2012.10.4.001.00
16. Commission of the European Communities. (2001). Making a European Area of Lifelong Learning a Reality. Brussels. Retrieved from: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2001:0678:FIN:EN:PDF
17. Khoo, E. T., Lee, S. P., Cheok, A. D., Kodagoda, S., Zhou, Y., & Toh, G. S. (2006). Age Invaders: Social and physical inter-generational family entertainment. In Conference on Human Factors in Computing Systems - Proceedings. https://doi.org/10.1145/1125451.1125503
18. European Commission. (2017). Eurostat-Data Explorer. Retrieved February 2, 2017, from appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do
19. Instituto Nacional de Estadística y Censos [INEC]. (2012). Censos 2011 | INSTITUTO NACIONAL DE ESTADISTICA Y CENSOS. Retrieved January 30, 2017, from http://www.19.go.cr/censos/censos-2011
20. Charness, N., & Boot, W. R. W. (2009). Aging and Information Technology Use: Potential and Barriers. Current Directions in Psychological Science, 18(5), 253–258. https://doi.org/10.1111/j.1467-8721.2009.01647.x
21. PROSIC. (2010). Los adultos mayores y las tic. Informe Anual Hacia la Sociedad de la Información y el Conocimiento. San José, Costa Rica. Retrieved from http://www.prosic.ucr.ac.cr/informe-2010
22. Thompson, G., & Foth, D. (2005). Cognitive-Training Programs for Older Adults: What Are they and Can they Enhance Mental Fitness? Educational Gerontology, 31(8), 603–626.
23. Czaja, S.J., Boot, W.R., Charness, N., Rogers, W.A., & Sharit, j. (2018). Improving Social Support for Older Adults Through Technology: Findings From the PRISM Randomized Controlled Trial. The Gerontologist, 58 (3), 467–477. https://doi.org/10.1093/geront/gnw249
24. Castro-Rojas, MD. (2018a). Using Information and Communication Technologies to facilitate cognitive activity and social interaction among older Costa Ricans. Denmark: Aalborg University Press.
25. Scherer, M. J., & Craddock, G. (2002). Matching person & technology (MPT) assessment process. Technology & Disability, 14, 125–131. Retrieved from http://web.b.ebscohost.com/ehost/pdfviewer/pdfviewer?sid=fd8e58c0-e19b-45b8-8ea3-edf576cb5eb0%40sessionmgr112&vid=23&hid=123
26. Salazar-Villanea, M. (2010). Recordando experiencias. Programa de intervención con reminiscencia para personas adultas mayores. Guís para terapeutas y CD con estímulos visuales. (1st ed.). San José, Costa Rica: Instituto de Investigaciones Psicológicas, Universidad de Costa Rica
27. Reker, G., Birren, J., & Svensson, C. (2012). Restoring, mantaining and enhancing personal meaning in the life through autobiographical methods. In P. T. P. Wong (Ed.), The human quest for meaning: theories, research, and applications (pp. 383–407). Routledge.
28. McQueen, M., McLellan, E., Key, K., & Milstein, B. (2009). Codebook development for team-based qualitative analysis. In K. & B. Krippendorff (Ed.), The content analysis reader (pp. 211–219). Los Angeles: SAGE.
29. Bates, D., Maechler, M., Bolker, B., & Walker, S. (2015). Fitting Linear Mixed-Effects Models Using lme4. Journal of Statistical Software, 67(1), 1–48.

https://doi.org/doi:10.18637/jss.v067.i01
30. Halekoh, U., & Højsgaard, S. (2014). A Kenward-Roger Approximation and Parametric Bootstrap Methods for Tests in Linear Mixed Models - The R Package pbkrtest. Journal of Statistical Software, 59(9), 1–30. https://doi.org/10.18637/jss.v059.i09
31. Hsieh, H.-F., & Shannon, S. E. (2005). Three Approaches to Qualitative Content Analysis. Qualitative health research, 15(9), 1277–1288. https://doi.org/10.1177/1049732305276687
32. Baltes, P., & Baltes, M. (1990). Psychological perspectives on succesful aging: The model of selective optimization with compensation. In P. Baltes & M. Baltes (Eds.), Successful aging perspectives from the behavioral sciences (First, pp. 1–34). NY: Cambridge University Press.
33. Lowe, C., & Rabbitt, P. (2005). Cognitive models of ageing and frontal lobe deficits. In P. Rabbitt (Ed.), Methodology of frontal and executive function (pp. 38–58). Hove, UK: Psychology Press.
34. Spector, A., Gardner, C., & Orrell, M. (2011). The impact of Cognitive Stimulation Therapy groups on people with dementia: views from participants, their carers and group facilitators. Aging & Mental Health, 15(8), 945–949. https://doi.org/10.1080/13607863.2011.586622
35. Westerhof, G. G., Bohlmeijer, E., & Webster, J. D. J. (2010). Reminiscence and mental health: a review of recent progress in theory, research and interventions. Ageing & Society, 30(4), 697–721. https://doi.org/10.1017/S0144686X09990328
36. Salazar-Villanea, M. (2015). Aproximaciones desde la gerontología narrativa: la memoria autobiográfica como recurso para el desarrollo de la identidad en la vejez. Anales en Gerontología (Vol. 7). Retrieved from http://revistas.ucr.ac.cr/index.php/gerontologia/article/view/17537/24842
37. Bluck, S. (2003). Autobiographical memory: Exploring its functions in everyday life. Memory, 11(2), 113–123. https://doi.org/10.1080/741938206
38. Spector, A., Orrell, M., & Woods, B. (2010). Cognitive Stimulation Therapy (CST): Effects on different areas of cognitive function for people with dementia. International Journal of Geriatric Psychiatry, 25(12), 1253–1258. https://doi.org/10.1002/gps.2464
39. Czaja, S. J., & Sharit, J. (2012). Designing Training and Instructional Programs for Older Adults. (W. Rogers & A. Fisk, Eds.) (First). FL: CRC Press Taylor & Francis Group. Retrieved from http://books.google.com/books?hl=en&lr=&id=Fe655VQDfRcC&pgis=1
40. Gibson, F. (2004). The past in the present. Using reminescence in health and social care. Illinois, USA: Health Professions Press
41. Mayring, P. (2000). Qualitative Content Analysis. Retrieved April 4, 2017, from http://www.qualitative-research.net/index.php/fqs/article/view/1089/2385
42. Smith, G. E., Housen, P., Yaffe, K., Ruff, R., Kennison, R. F., Mahncke, H. W., & Zelinski, E. M. (2009). A cognitive training program based on principles of brain plasticity: Results from the improvement in memory with plasticity-based adaptive cognitive training (IMPACT) study. Journal of the American Geriatrics Society, 57(4), 594–603. https://doi.org/10.1111/j.1532-5415.2008.02167.x