

Research Article

Development of the Training Platform “AD-GAMING” for the Improvement of Quality of Life of People with Dementia through “Serious Games”

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AD-GAMING is a platform (www.adgaming.ibv.org) which focuses on increasing the technological skills of people with dementia (PwD), their families and caregivers, thus allowing them to use Serious Games (SGs) with the purpose of improving their quality of life. This program promotes the equity and inclusion of PwD, as it allows them to be an active part of their communities through gaming with their families and peers. The development of the platform was based on collaborative design principles and the evaluation through focus groups with PwD, caregivers and health professionals. Although research continues to show SGs may offer benefits for PwD and their families, the uptake of such applications is still low. This has been attributed to a range of barriers. The main product of this project, the training platform, will be a good solution to such issues and difficulties.

Keywords: Dementia; Serious Games; Quality of Life; ICT technology; collaborative design**Abbreviations**

PwD: People with dementia; PwA: People with Alzheimer; SGs: Serious Games; ICT: Information and Communication Technologies; QOL: Quality of Life

Introduction

Currently there are approximately 47 million PwD across the globe with 10 million of them located in Europe. Alzheimer disease is affecting 10% of the global population over 65 years old and nearly 50% of those over 85 years old [1]. This disease affects not only the individuals but also their families and caregivers. The cognitive symptoms of Alzheimer's disease, the most often kind of dementia, affect memory, communication, orientation, ability to maintain attention, recognition of stimuli, ability to perform movements with an intention, calculus capacity and body schema [2,3].

The disease progression may be faster or slower depending on the environment of the people with Alzheimer (PwA). Disease accelerators are considered to be family stress, sudden changes in daily routines or change to a new and unfamiliar environment (such as a nursing home). Factors that can delay the disease are considered to be happy family atmosphere, social inclusion, exercise and participation in cognitively stimulating activities [4].

There is strong evidence suggesting that stimulation of cognitive abilities helps slow the decline of functions and abilities, and consistently improves cognitive functioning, and is also associated with benefits in Quality of Life (QoL) and communication. This stimulation consists in exercising those areas still preserved by the patient [5-7].

In the last decades there has been a growing interest in employing

Information and Communication Technologies (ICT) to help assess and evaluate patients' functional impairments, as well as to help and support patients in everyday activities [8,2,9]. This is the underlying idea for the development of SGs. Therapies based on SGs to stimulate cognitive abilities of PwA are exhibiting good results when they are used with people with mild and moderate symptoms [10]. Furthermore, McCallum and Boletsis [11] reviewed SGs for Dementia, and reported mostly positive health effects and successful implementation.

SGs are digital applications or games that can be used for entertainment but also have other important purposes, such as training and educating, communicating, or promoting the use of cognitive, physical and social abilities [12,13]. SGs are often specifically designed and targeted at certain populations such as people with mild and moderate dementia. However, more recent research has suggested that commercially available gaming technology can also be used to benefit the well-being of PwD and their care partners. Some specific games have been developed but there are also traditional games whose use could have a positive impact in PwA [10]. For the purposes of this project, the SGs outlined on the website include games that are both technology-based and not technology-based and that have either been designed for a specific rehabilitation purpose or are more widely available as entertainment tools.

However, the potential of using SGs to improve the QoL of PwA is not fully developed, due to a lack of the selection and prioritization of SGs based on their positive influence on different cognitive symptoms and the lack of guidelines for the use of the most suitable SGs for specific problems of PwA. Also, some other important issues are the lack of caregiver knowledge about the use of SGs according to patients' particular conditions, the absence of training of PwA in an

adapted and accessible way, about the benefits of exploiting SGs as a tool for improving their QoL, and the lack of a family structure that could support participation of PwA in such games with the aim of social inclusion.

Therefore, AD-GAMING website (www.adgaming.ibv.org) has been designed to raise awareness, and encourage the use of SGs amongst PwD, their care partners and practitioners by providing recommendations for overcoming some of the barriers outlined above. Whilst the researches illustrated above cover a broad range of technologies, the aim of this website is to provide more specific information and recommendations on using SGs with PwD and their care partners. The recommendations set-out below are based on that obtained from research within the field.

This training program is unique and innovative because it is based on the development of an adapted e-training platform including ICT solutions addressed to PwA with various levels of disability. Also, AD-GAMING focuses on SGs as innovative therapy and includes the direct involvement and training of PwA. It is a program that aims at the promotion of the inclusion of PwA through the participation of the caregivers of these people and the approach of “playing” with members of the wider community apart from the personnel of medical and therapeutic facilities. AD-GAMING is launched with the main objective of increasing the competences (attitudes, skills, knowledge) of the collective around people with mild and moderate AD (persons, families and caregivers) about how to exploit SGs for increasing their QoL, through an innovative training program. The project has the following specific objectives:

- Create awareness and motivation about the importance and possibilities of SGs as a tool for improving QoL of PwA.
- Promote and make available a prioritized selection of SGs aimed at the specific needs of various PwD.
- Train members of the public, families and professionals about how to play SGs with PwD and inform them about the specific therapeutic purposes of SGs.
- Promote digital and technological skills, which allow PwA and their supports to properly exploit ICT-based SGs.
- Involve professionals and families in the training process in order for them to be able to support PwA.
- Increase the social inclusion of PwA, through the participation of families in SGs in domestic environments.

Method

Design and Procedure

The project team was led by Alzheimer’s Valencia and was supported by five European partners: Bournemouth University Ageing and Dementia Research Centre (ADRC), Alzheimer’s Slovenia, Alzheimer’s Romania, Greek Association of Alzheimer Disease and Related Disorders (GAARD) and the Institute of Biomechanics of Valencia (IBV). Each partner shared the basic information about the existing innovations and best practices. The project began in September 2016 and run for two years. The research consisted of three phases:

Phase 1: Initial feedback from key stakeholders on selected Serious Games

According to their previous background and experience in the field of SGs for PwA, the project team decided which SGs should be included in the Training Program. The evaluation and selection of SGs were according to the impact and applicability to the 8 cognitive symptoms evident in Alzheimer’s disease: i) Memory Loss; ii) Loss of ability to communicate; iii) Disorientation; iv) Attention disorders; v) Agnosia; vi) Apraxia; vii) Loss of capacity of calculation; viii) Loss of body schema. Also, attention was paid to the availability of these games and the barriers and supports needed for their use by PwA.

In order to introduce PwD, their care partners and health professionals to a range of SGs selected by the project team and elicit their opinions of engaging with them, interactive workshops were designed. Throughout the workshops, data was elicited through multiple qualitative methods, including:

- Reflexive field-notes and ‘in-the-moment’ observations from researchers and practitioners.
- Focus group discussions with PwD and their care partners (immediately after the workshop was concluded).
- Discussions with healthcare professionals with experience of using SGs with PwD.

The selection criteria of PwA to be involved had been to recruit those who are in the early stages of the illness, suffering mild or moderate symptoms, because they are the people who can improve their cognitive situation. People with severe AD had been excluded from the project because they are not able of using SGs and/or they cannot get any positive impact from its use. Additional participant’s characteristics are presented in Table 1.

In these Working Sessions, PwA played some of the final SGs and gave feedback about their experience. Some general and specific questions about the workshops, the platform and the SGs were asked to the participants. There are more details about the focus group discussion and the interview questions in the Box 1.

This data was used to develop the Methodological Guide. This Co-Created Methodological Guide is a document for training PwA and their caregivers on the implementation of inclusive cognitive and physical activities. It is a product created with the direct participation of end users, its main objective being the determination of the key contents, methodologies and tools needed for creating and improving the critical competences of PwA and their caregivers for using SGs with the aim of improving their cognitive functioning.

It is crucial to underline that AD-GAMING was indeed devoted to the study and development of a training methodology to properly involve PwA together with their families and professionals. Training Methodology and supporting tools, including ICT supporting tools were developed from the beginning according to Accessibility and Usability criteria. Therefore specific methodologies, tools and ICT solutions were developed in order to make their participation as easy as possible.

Phase 2: Development of the online platform and training documents

The activity that followed these results was the development of

Table 1: Demographic details of the participants in Phase 1.

Country	Number of workshops	Number of care partners (CP)/Health professionals (HP)/PwD	Age in years (range)	Gender (M/F)
Spain	2	6 CP/7 HP/8 PwD	19-75	3/19
England	2	6 CP/11 HP/15 PwD	18-70	15/11
Romania	1	5 CP/4 HP/4 PwD	24-80	3/11
Slovenia	4	11 CP/9 HP/15 PwD	25-79	2/27
Greece	1	6 CP/4 HP/10 PwD	35-82	7/12
Total	10	120(34 CP/34 HP/52 PwD)	18-82	30/80

CP: Care Partners; HP: Health Professionals; M/F: Male/Female.

Table 2: Demographic information of the participants in Phase 3.

Country	Number of workshops	Number of care partners (CP)/Health professionals (HP)/PwD	Age in years (range)	Gender (M/F)
Greece	10	40 CP/ 5 HP	35-82	9/36
Romania	10	40 CP/ 5 HP	25-82	10/35
Slovenia	9	45 CP/ 18 HP/ 15 PwD	26-81	11/67
Spain	7	38 CP/ 5 HP	20-79	13/30
UK	10	43 HP	24-71	7/36
Total	46	254 (163 CP/ 76 HP/ 15 PwD)	20-82	50/204

CP: Care Partners; HP: Health Professionals; M/F: Male/Female.

Training Materials. They include general information, but also specific information for each SG and about the cognitive dimensions of AD. The main purpose is to create and improve the critical competences of PwA and their caregivers for using SGs to improve their cognitive abilities and overall QoL.

The next step after these activities was the development of an e-Training Platform, including ICT Tools for supporting the understanding and implementation of the Training materials and Designed Experiential Practical Activities.

Phase 3: Evaluation of the online training platform and training documents

During phase 3, data was collected through a series of workshops. The objectives of the workshops were to:

- Introduce PwD, care partners, family members and dementia practitioners to the SGs online platform, developed in phase 2.
- Explore the accessibility and usability of the training platform.
- Examine the content of the training documents.
- Understand the potential benefits for PwD.

Each workshop ran for approximately 2 hours. Throughout the workshops, data was elicited through multiple qualitative methods, including:

- Reflexive field-notes and ‘in-the-moment’ observations from researchers and practitioners as they explored the training platform independently.
- Focus group discussions with dementia practitioners following a demonstration and exploration of the platform.

Two weeks post the completion of the workshops, the participants were contacted again and a short telephone interview was conducted

to ascertain whether they had used the training platform within their practice with PwD. Additional participant’s characteristics are presented in Table 2.

Results

Phase 1: Initial feedback from key stakeholders on selected SGs

In the workshops a total of 28 technological and non-technological based SGs were introduced into 52 PwA, 34 care partners and 34 health professionals. As we described above in the methodology, the project team decided which SGs will be tested according to their previous background and experience in the field of SGs for PwA, according to the impact and applicability to the 8 cognitive dimensions and the availability, the barriers and supports needed for their use by PwA. Furthermore, the main content and approach of the training methodology and tools of the workshops was based on a short guide “Using ICT in activities for PwD”, created by Social Care Institute for Excellence and used by University of Bournemouth [14].

Also, at the begging, methodology, information and tools for guiding the Co-Creation sessions were developed and agreed among partners. Partners collected and shared basis, recommendations and tools for improving active and healthy ageing through the exploitation of Assistive Technologies, to be used in the Co-Creation Working Sessions. During the Sessions partners and PwA discussed about the more relevant SGs, based on both cognitive and QoL criteria, about the key factors and tools for getting a successful transference of knowledge, and agreed on the specific characteristics of the Training Materials, Designed Experiential Activities and e-Training Platform (some interviews questions in the Box 1).

As participants engaged with the SGs, feedback data was collected through researcher’s observations and verbal feedback from the players. The data collected included: positive aspects of the games; the challenges that players faced when interacting with the SGs; and any solutions that were found to enhance the players’ experiences of

Table 3: Non-technological games played in Phase 1.

Games	Positive aspects	Challenges	Solutions
Word game	<ul style="list-style-type: none"> Promoted socialisation and teamwork to accomplish task. Promoted creative and problem solving skills as well as concentration. Promoted memory, observation and language skills. Promoted a sense of enhanced mood and fun. Did not require any physical activity. 	<ul style="list-style-type: none"> Cards can be difficult to read and contain too many details/stimuli. Cards can be difficult to pick up and place on the table. Difficulty understanding specific words. Competition to gain the highest scores can cause distress. Difficulties understanding instructions. Difficulties with a lack of vocabulary, particularly as the difficulty level increased. Difficulties concentrating in large groups or in a noisy environment. 	<ul style="list-style-type: none"> Use bigger cards with less detail on them. Players with dexterity issues were not required to pick up the cards. Emphasise that the game is not a competition and provide more time for some participants. Simplify the rules and reduce the amount of instructions. Ensure the game is played in a quiet environment and/or smaller groups. Categorise the words that players are required to find. Support worker can repeat the words that have been used already.
Maze Games	<ul style="list-style-type: none"> Play alone or in a group Promoted creativity to solve the maze. Promoted concentration and co-ordination. 	<ul style="list-style-type: none"> Materials were small and difficult to use for some people to use. Those with poor eyesight or issues with hand dexterity struggled to engage. 	<ul style="list-style-type: none"> Use larger materials.
Dual Task	<ul style="list-style-type: none"> Enhanced sense of mood. Enjoyed listening to music. Promoted memory and attention skills. 	<ul style="list-style-type: none"> Difficult to concentrate on the conflicting tasks. 	<ul style="list-style-type: none"> Provide reward when achieved the objective. Provide clear and simple instructions.
Shapes	<ul style="list-style-type: none"> Fun game that promoted collaborative working. Promoted concentration. Participants were accustomed to the recognisable shapes and materials. Different levels of difficulty that can be tailored towards the player. 	<ul style="list-style-type: none"> Materials were difficult to use. Complicated instructions. 	<ul style="list-style-type: none"> Use larger shapes. Provide clearer, simpler instructions. Play the game in groups so players can offer support to others.
Tactile disks	<ul style="list-style-type: none"> Promoted socialisation and collaborative working to overcome the challenge. Promoted concentration and memory. 	<ul style="list-style-type: none"> Sometimes difficulties understanding the rules of the game. 	<ul style="list-style-type: none"> Encourage people to work together to find the solution. Use larger materials. Players improved with practice, therefore require a longer time to become accustomed to the game.
Pixels	<ul style="list-style-type: none"> Promoted concentration and challenges for co-ordination Colourful materials that were easy to use Fun game that promoted socialisation and collaborative working. 	<ul style="list-style-type: none"> Difficulties telling colours apart if they were similar (red/orange). Difficulty for some people to maintain attention. Difficulty moving the pins on the board. Difficulty understanding and following instructions. 	<ul style="list-style-type: none"> Some of the colours could be taken away and replaced with others ones that were dissimilar. Use larger pins. Facilitator can remind players of the correct procedure to follow.
Hangman	<ul style="list-style-type: none"> Fun games with clear objective. Promote social interaction and creativity. Used problem solving and language skills. Promoted sense of enhanced mood. 	<ul style="list-style-type: none"> Some players found it difficult to process language. Some players found it difficult when the words were too long. 	<ul style="list-style-type: none"> Use phrases that are familiar to people and provide a sense of reminiscence or categorise the answers (eg. Objects of clothing). Facilitators provide clues by pointing to objects that may help players to solve the puzzle. Use shorter and simpler words.
Motoric Tree	<ul style="list-style-type: none"> Fun game with attractive materials. Promoted attention and co-ordination. Some players enjoyed the challenge. 	<ul style="list-style-type: none"> Some players struggled with rotating the shapes. 	<ul style="list-style-type: none"> Players improved with practice and so important they were given enough time to play.
Match pairs	<ul style="list-style-type: none"> Colourful and engaging game. Fun game. Enhanced sense of mood. Encouraged players to use their memory. 		<ul style="list-style-type: none"> Use more personalised content such as family pictures.

engaging with the SGs. Tables 3 and 4 below include some examples of the feedback. The main categories for the description of each game (positive aspects, challenges and solutions) were according to the Guide “Using ICT in activities for people with dementia” [14].

After the Workshops the Co-Created Methodological Guide

was developed, with the direct participation of end users. Its main objective was determining the key contents, methodologies and tools needed for creating and improving the critical competences of PwA and their caregivers for increasing their QoL through the exploitation of “SGs”. The Co-Created Methodological Guide also includes:

Table 4: Technological games played in Phase 1.

Brain Tuner	Positive aspects	Challenges	Solutions
Shadows	<ul style="list-style-type: none"> Fun and interesting game. 	<ul style="list-style-type: none"> Some players were anxious to get the answer correct or unable to complete the task in the allotted time. Can be difficult for people with visual problems. 	<ul style="list-style-type: none"> Use a projection screen to encourage group interaction. Increase the difficulty as players improved with practice. Increase the size of the silhouettes. Allow more time for people to engage with the game.
Supermarket	<ul style="list-style-type: none"> Promoted enhanced mood and concentration. Promoted satisfaction when achieved goal. The game was applicable to activities of daily living. Attractive game with an engaging design. Promoted mathematical abilities. Promoted collaborative working. 	<ul style="list-style-type: none"> Difficulties engaging with the touchscreen. A difficulty reading the banners as the writing was small. 	<ul style="list-style-type: none"> Provide players more time to interact with the technology and engage with the game. Have the PC as a platform for the game rather than iPad.
Brain Tuner	<ul style="list-style-type: none"> Promoted mathematical abilities and cognitive stimulation. Simple and easy to follow. Applicable to activities of daily living. Engaging colours and easy to read numbers. 	<ul style="list-style-type: none"> None. 	<ul style="list-style-type: none"> Could provide rewards when objective is achieved.
Sea Hero Quest	<ul style="list-style-type: none"> Fun and adventurous game with clear objective. Promoted enhanced mood, collaboration and social interaction. Attractive and engaging game that caught people's attention. Good use of rewards at the end of each level. 	<ul style="list-style-type: none"> Sometimes difficulties moving the boat. Difficulties with the touchscreen. 	<ul style="list-style-type: none"> Have a video with the demonstration of the game next to the player as they engage with it. This will remind them of the target. After practice players became more competent at engaging with the game.
Large pieces jigsaw	<ul style="list-style-type: none"> Engaging colours and shapes. Enhanced sense of mood. Promoted collaborative working. 	<ul style="list-style-type: none"> Difficult to understand the objective of the game. Difficulty with the touch screen technology. 	<ul style="list-style-type: none"> PC version of the game. Clearer instructions to understand the purpose of the game or a video outlining the objective.
Kinesiotherapy	<ul style="list-style-type: none"> Promoted physical exercise and enhanced sense of mood. Promoted collaboration. Promoted the use of memory. Promoted physical exercise. 	<ul style="list-style-type: none"> None. 	<ul style="list-style-type: none"> Provide a reward when objective is achieved. Clear instructions on the purpose of the game.
Kinect sports	<ul style="list-style-type: none"> Promoted fun and enhanced mood, particularly bowling and golf game. Promoted concentration. Engaging game with colourful graphics. Promoted reminiscence. Promoted competition and collaboration. People improved through practice. Did not require the use of a controller. 	<ul style="list-style-type: none"> Games such as tennis and football were more difficult as they were played at a faster pace. Difficulty with positioning required when engaging with the game. On occasions more difficult using the sensor for left handed people. Some people had difficulties understanding the sensor. Difficult for people in wheelchairs. 	<ul style="list-style-type: none"> Use markings on the floor to indicate where people should stand. Provide support to navigate the instruction screens.
Maths Run	<ul style="list-style-type: none"> Fun game with colourful/engaging graphics. Promoted calculation skills. Promoted attention. Easy to understand game. 	<ul style="list-style-type: none"> Some graphics could be a little off-putting such as the fireworks. Difficulties with some of the calculations. 	<ul style="list-style-type: none"> Reward system so players are aware when they have answered a question correctly.

<p>Nintendo Wii sports and balance board</p>	<ul style="list-style-type: none"> • Promoted physical exercise. • Promoted fun and enhanced mood. • Promoted competition. • Promoted sense of balance. • Engaging game with colourful graphics. • Promoted reminiscence. • Promoted competition and collaboration. • People improved through practice. • Games could be played sitting down. 	<ul style="list-style-type: none"> • More complicated movements that required a controller. • Games such as tennis and football were more difficult as they were played at a faster pace. • Some people had difficulties understanding the sensor. • The balance board could be difficult for some people to understand. 	<ul style="list-style-type: none"> • Players improved with practice. • Provide support to navigate the instruction screen.
<p>Google Earth</p>	<ul style="list-style-type: none"> • Fun and entertaining game with engaging colours. • Promoted reminiscence. • Promoted socialisation and collaboration. • Enabled people to view the world. • Generated ideas for future places to visit. 	<ul style="list-style-type: none"> • Difficulties navigating the screen, particularly with finger dexterity issues. • Difficulty viewing the screen on the iPad. • Game can be quite short. 	<ul style="list-style-type: none"> • Stylus can support interaction with iPad. • iPad can link to a TV screen. • Practice with the iPad can improve abilities. • Playing in groups to promote discussion. • Provide clearer motivations on what you would like players to find. Have a list of questions that you can set players to answer.

- The training program as an outline of the training process.
- The evaluation and determination of SGs to be included in the Training Program.
- Key competences related to the exploitation of SGs by PwA and critical points in which trainees should improve after the training.
- Key factors for getting successful knowledge transference to PwA in terms of training approach.
- Evaluation and determination of specifications and approach of the Training Materials and Designed Experiential Training Activities.
- Evaluation and determination of technical specifications and approach of the e-Training Platform in terms of accessibility, usability and applications to be included.

Key Findings

It is crucial to underline some of the main outcomes relevant to the environment, the technology and the professionals who take care of PwA, that are included in the Methodological Guide.

First of all, according to our results, it is important to create an environment where people feel safe to engage with the SGs. When using sensor technology such as the Nintendo Wii or the Microsoft Kinect, it is important that players have enough space to move around without fear of hitting others. The television should be positioned at eye level and the sensor can be placed above or below this. It may also be worth placing other chairs in a semi-circle around the television screen (but at a safe distance from the players) so that those not engaging with the games can still watch. This means that even if people are not playing the SGs then they can feel a sense of enjoyment from it.

When using SGs that require people to sit down to interact with them then it is important that practitioners provide a space where players can sit at a table. Arranging the tables in a circular fashion will also encourage people to socially interact as they engage with the SGs. Practitioners may also wish to consider having care partners sit and watch the SGs even if they don't interact with them. Research has

shown that this can challenge some of their views of the capabilities of PwD and is also likely to encourage socialisation between the care partner and person with dementia [15].

Between 1.5 and 2 hours is probably the optimal time for engaging people with dementia in SGs. The effectiveness of this duration for non pharmacological interventions has been well demonstrated through research findings and also from the experience of implementing non-pharmacological interventions in the GAADR day centres during the last 10 years [16,17,7]. This duration provides enough time for PwD to play the SGs at their own pace, and provide feedback on their experience. Any shorter and people may feel rushed, and any longer and people may begin to disengage.

It is important that PwD are enabled to interact with the SGs and the technology independently. Practitioners should be aware of the support they provide to players and ensure they are not being over-controlling. For example, if users struggle to hold the weight of the tablet as well as interact with it, then practitioners should avoid taking over the game, but instead hold the tablet to enable the player to engage with the game with both hands. Similarly, practitioners should consider having their own controller when instructing PwD to use the Nintendo Wii. This way they can point to the button or carry out the action on their controller whilst instructing the player to do likewise on theirs. Of course, on occasions and with certain people (depending on their capabilities) it may be necessary to provide more support, but it is important for practitioners to be mindful that their aim is to empower PwD whilst they interact with the game.

When first engaging PwD with SGs, practitioners would be advised to begin by using simple games and to attempt to tailor these to the interests of the players. Research has shown that PwD are more likely to interact with activities if they are tailored to their personal interests [18]. It is important that practitioners find out this information prior to running SGs sessions with PwD. Where applicable, it is also beneficial to keep the volume high on the SG. Often the music is fun and engaging, and this is likely to encourage people to interact with the game.

Easier SGs tends to be those games that have slower graphics,

have relatively straight-forward goals and do not require complicated movement and button combinations. It is important that practitioners assess the difficulty level of the games before engaging PwD. If a game is too hard for a person, then they are likely not to return to it and this may discourage them from attempting to play any other SGs in the future. Most SGs offer difficulty settings and so it is important for practitioners to ensure that these are set to the easiest level at the beginning; they can always be adjusted as players improve.

Practitioners may find that some PwD are more confident at engaging with the SGs than others. In these instances, practitioners would be advised to encourage the more confident people to play the game first and enable those who are less confident to watch. This is likely to reassure those who were initially apprehensive and so inspire them to also play the SGs. It may also be possible for practitioners to pair up the more confident players with those that are less confident, and so encourage them to work together to engage with the SGs. Encouraging players to engage with group-based SGs is a good way to promote social connections and conversations.

It is important that practitioners regularly collect feedback on the appropriateness and fun factor of the SGs from PwD and their care partners. This feedback can be used to inform future sessions and decisions on other SGs that users may wish to play. Quantitative measures (such as questionnaires on QoL or well-being) can be used, although these are often not subtle enough to pick up on 'in-the-moment' benefits for PwD. As such, the best way to obtain feedback on the SGs is to ask those people playing the games and watch them as they interact with them. This qualitative data will ensure that practitioners can continue to engage PwD in SGs that will appeal to them and therefore likely to bring them benefits.

When engaging in feedback discussions, practitioners would be advised not to focus solely on those members who are more outgoing or loud. Whilst the information they provide will be important it may not be representative of the whole group. It is essential that practitioners also look to include the quieter members in the conversations as well. Practitioners would also be advised to adjust their approach when engaging PwD for feedback. Some may respond better in a group situation where as others may be better in a one-to-one situation.

Phase 2: Development of the online platform and training documents

The final SGs that had been selected are Shapes, Word scramble, Hangman, Pixels, Sea Hero Quest, Math Run, Google Earth, Wii Sports, Match pairs, Bingo, Matchstick Math, Tactile disks, Motoric tree, SixStix, Kinect sports, Kinesiotherapy, Supermarket, Virtual Garden, Dual Task, Number balance, Word games, Large pieces jigsaw, 3 D Flash Chess, Maze games, Brain tuner, Driving and parking cars games. The main criteria were to include at least five games from each country, which are well developed, tested, available and focused on the 8 cognitive dimensions. Furthermore, there is also literature evidence that these SGs are effective and usable for PwA [7,15,19,20-23]. For example, Padala et al. [24] in their research used a relatively large number of participants (N=22) and had a high number and frequency of gaming sessions (5 sessions per week for 8 weeks/participant), showing that the PwD could benefit from WiiFit in acquiring better balance and gait, compared to a walking program.

Training Materials addressed to PwA, families and professionals for facilitating the exploitation of SGs were developed including:

- Basics for improving the cognitive situation and global QoL of PwA through the exploitation of SG.
- The available SGs which focused on cognitive symptoms and the improvement of the QoL of PwA.
- Guidelines for evaluation of personal needs and criteria for proper SGs selection.
- Guidelines for playing the selected SGs depending on the cognitive symptoms to be focused on, conditions of PwA, participation of professionals or families, use in assistive centers or domestic environments, etc.
- Basic and easy-to-understand guidelines to develop digital and technological skills directly related with the exploitation of ICT-Serious Games.
- Adapted Training Materials developed in different modules adapted to the target stakeholders (PwA, families and professionals) and roles (trainers and trainees), including text-based information, presentations, videos, games and exercises.

Phase 3: Evaluation of the online training platform and training documents

Each partner undertook workshops within their respective countries throughout April-July 2018. The workshops aimed to introduce the SGs platform to dementia practitioners (formal and informal caregivers) whilst recording observations of how they navigated through the platform, as well as their opinions about the benefits and limitations of the platform. Each of the workshops focused on one of the 8 dimensions that make up the SGs platform: memory, attention, orientation, calculation, praxis, language, perception and executive function.

Forty six (46) workshops were undertaken across the 5 countries, with 254 participants taking part in the evaluation. The participants included 163 informal care partners, 75 health professionals and 15 PwD. The majority of the participants were female (204) and their age ranged from between 20 years old to 82 years old (Table 2).

A synthesis of the data collected from all partners has been outlined below. This includes feedback from informal care partners and dementia practitioners. The findings have been separated into three main themes: Benefits of the Serious Games Platform, Aesthetics of the Platform, and Accessibility of the Platform. The strengths and limitations, as identified by participants, have been outlined below alongside recommendations to consider during the development of the online platform.

Benefits from serious games platform:

- Care partners and dementia practitioners warmly welcomed the SGs platform and felt that they would use it regularly within their practice to enable them to prepare activities that would be welcomed by PwD. They appreciated the fact that the platform provided them with both ICT and non-ICT games that they could use within their practice. Care partners also felt that they would use it within their homes with their grandchildren and so break down intergenerational barriers.

- Care partners and dementia practitioners highlighted the need to provide the benefits of SGs within the platform as this began to challenge their perceptions of using them with PwD.

- It was also considered beneficial that the platform provided a range of diverse games (and alternative games) and offered them a detailed understanding of the games and how they could be used with PwD in both a one-to-one scenario and in a group setting. They also appreciated information that outlined how the games could be adapted to the interests and capabilities of the PwD they are working with.

- The platform has good value in aiding social inclusion of PwD by giving ideas on how to be more inclusive and build relationships through ideas (and adaptations of games) health professionals might not have thought of.

- Care partners and dementia practitioners felt that the additional information about the psychological benefits of the SGs was beneficial because it provided some gravitas and scientific purpose to their activities.

- Both care partners and dementia practitioners reported that the collaborative space would be useful to them and that they would probably use this feature of the platform.

- The help/tutorial tab was considered very useful and easy to use. It provided good information on using the SG platform.

Aesthetics of the platform:

- A common theme was that the grey background and lack of pictures made this exciting platform seem less appealing and more difficult to navigate.

- Although most of the practitioners and care partners found the information about dementia interesting, some disliked the large blocks of text. The initial text at each game (in blue italics) was considered hard to read.

- Practitioners felt that due to time pressures in their job, they would not realistically have the time to read large blocks of text such as those present at the “General Materials” section. As such, this information was deemed secondary in importance to the information provided on the games themselves. Care partners had more time to absorb the information on the platform and so this was not considered as big problem for them.

- Suggestions for improvement from experts and caregivers:

- Improve direct access to the platform from the home page. The buttons should be clearly visible.

- Modify the color design of the platform. Some more specific suggestions are: add extra pictures, more images or a subtle colored background.

- Present the information in the “General Materials” section (about dementia, the cognitive areas and the serious games’ strategies) in a more accessible format e.g. concise bullet points that are broken up with pictures, or a series of short video clips on each of the cognitive areas. Another suggestion might be to offer the information in dropdown tabs or linkable chapters so that it looks

less daunting, but people can select certain information to read if they are interested.

Accessibility of the Platform:

- Some practitioners stated that they may benefit from an option to search for games according to PwD’s interests, in accordance with the person-centred manner that they are accustomed to working in, rather than purely searching in relation to cognitive dimensions or the cognitive deficits of PwD. These interests could include gardening, sports, arts, reminiscence and travelling, card games, word games, driving games etc. Many practitioners also wished to search for games according to difficulty levels (e.g. easy, medium and difficult).

- Barrier reported by care partners and dementia practitioners was the lack of technological devices that they owned at home. This would prevent them from using these devices outside of a work setting.

- More physical exercise games could be provided on the SGs platform as this would mean that they could be played at home and care partners wouldn’t need to purchase additional technological equipment.

- A frequent barrier was that some practitioners and many of the care partners did not understand the meaning of some of the psychological terms commonly used within the training platform and this made them hesitant to select these options in the search function. These words included ‘gnosis’, ‘Kinesiotherapy’, ‘Executive Functions’, ‘calculus’ and ‘Praxis’. Also, some practitioners felt that the term ‘physical’ games indicated that these games involved some level of physical exercise, rather than just being a non-ICT game.

- Simplifying some of the language into layman’s terms to remove the academic barrier would make the platform more accessible. This is also likely to improve the accessibility for informal care partners who may have limited understanding of psychological terms. Also, changing ‘physical’ games to ‘non-computerized’ or ‘non-digital’ games (and use of the term digital rather than ICT) could aid comprehension by non-specialists.

Discussion

The data collected from all these workshops demonstrated that the practitioners and care partners found the SGs training platform useful and were excited about the prospect of using it to support the well-being of PwD. These results are in accordance with a huge amount of research in the field of SGs and PwD [7,12,15,19-23,25].

However, at present, there were some issues with the presentation of the information on the platform as well as its accessibility, which they felt needed to be addressed before they could successfully adopt it within their daily practice. They were predominantly focused on ensuring the website was more colorful and engaging, the language was user-friendly with less psychological jargon, and the search function for the games was more person-centered (so the activities could be better tailored towards the interests of PwD) and more prominently displayed. Chi, H., et al [12] in an assessment analysis for mHealth apps and on-line Smart Thinker suite of SGs for PwD underlined the need for SGs to be user-friendly, simple to understand, easy to play and easily accessible on home computers.

According to our results, although practitioners may wish to use SGs with PwD and their care partners, it is important they first explore whether there is an interest for this. If PwD and their care partners have no interest in learning about the technology or engaging with it, then any SGs initiative is likely to fail from the very start. It is advisable that practitioners approach their intended audience, prior to purchasing any technology, to establish whether this is something that would be of interest. Mayer M. and Zach J. [26] found that using simple games specifically customized for PwD ease the process of eliciting user needs, enhance the interest of these people and realistic prototypes allow design evaluations with PwD early on.

However, it is also important to consider that a lot of PwD and care partners will be unaware of the technology available for them to use, and consequently may also be fearful of it [23]. In these situations, it is advisable that practitioners bring some of the technology they intend to use along with them to these preliminary meetings and use it as part of a “taster session”. During this “taster session” practitioners can display the technology and SGs they are interested in using and explain some of their benefits.

The participants at the validation pointed the positive aspects of both the platform and the contents. They underlined that there is a good balance of contents and many useful and practical information. The platform is accessible and easy to use. Participants also suggested the topics that could be improved or changed. For example, for them is important the platform to have more user-friendly language and less technical jargon and more images and videos to increase the attractiveness of the contents. They underline that it is crucial to ensure the correct functioning of all the links and references and provide them in national languages and to improve some design aspects (colors, buttons, and information layout).

Using the results of this validation, and the internal revision of the contents, the consortium discussed a list of improvements. Most of the suggestions have been implemented at the platform, while others have been rejected due to technical reasons or because they have not been considered a priority. Some of the suggestions rejected have been added to future revisions of the platform, as stated at the exploitation plan. For example, according to the feedback of the phase 3, in the final version of the platform, audios to the video tutorials, practical activities to all the games and introductory texts to the Main platform page were added. Improvements to the direct access to the platform from the home page like button clearly visible and sub menus were implemented. The consortium also added moderators of each partner for the national Forums and put on the games and the general materials a box sentence inviting to use the collaborative space. These changes will improve the usefulness of the platform. Finally, some improvements in the search of games like the dropdown list at the search criteria, to avoid that the users think that more than one search option is possible were also important to be changed.

In conclude, it is crucial to underline that involving PwD as co-designers in the development of technology is deemed challenging, but not impossible. However, even with the update and expansion in the current project, specific insights in appropriate research methods and materials is still lacking [27]. Extensive reports on the methodology and evaluation of the experiences of involvement of the PwD themselves are generally missing. This makes appreciation of the

active involvement of PwD and creates co-design difficulties within this combined field. Future research and projects should therefore continue to concentrate on and characterize how methodologies and materials could be collected, designed and implemented.

Conclusion

AD-GAMING is an innovative platform for increasing the technological skills of PwD, their families and caregivers, through the use SGs and focuses on improving their quality of life. Many research show that SGs can offer benefits to PwD and their families, but there are still a range of barriers. The results of this project show that this training platform can be a solution to such issues and difficulties. This program, aims also to enhance the equity and the inclusion of PwD, as it allows them to be an active part of their communities through gaming with their families and peers.

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Ethics Approval

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