LILIANA FILIPA VALE COSTA

OS JOGOS COMO ESTRATÉGIA DE APRENDIZAGEM PARA UM ENVELHECIMENTO ATIVO

GAME-BASED LEARNING FOR ACTIVE AGEING

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LILIANA FILIPA VALE COSTA

OS JOGOS COMO ESTRATÉGIA DE APRENDIZAGEM PARA UM ENVELHECIMENTO ATIVO
*Co-designing*, desenvolvimento e avaliação de um jogo

GAME-BASED LEARNING FOR ACTIVE AGEING
Co-designing, developing and assessing a game-based tool

Tese apresentada à Universidade de Aveiro para cumprimento dos requisitos necessários à obtenção do grau de Doutoramento Europeu em Informação e Comunicação em Plataformas Digitais, realizada sob a orientação científica da Doutora Ana Isabel Veloso, Professora Auxiliar do Departamento de Comunicação e Arte da Universidade de Aveiro, e sob a coorientação do Doutor Michael Loizou, Investigador Associado do Disruptive Media Learning Lab da Universidade de Coventry.

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To my dearly beloved grandmother Rosa.

À minha querida avó Rosa.

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o júri

presidente

Prof. Doutor Fernando Manuel dos Santos Ramos
Professor Catedrático do Departamento de Comunicação e Arte da Universidade de Aveiro

Prof. Doutor Sylvester Arnab Anak Lucas Sadin
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agradecimentos

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palavras-chave

jogos digitais, envelhecimento ativo, bem-estar, qualidade de vida, aprendizagem

resumo

As exigências atuais que decorrem da Sociedade da Informação e Comunicação, por vezes, excluem certos grupos, quer pela idade, quer por não fazerem parte da população ativa, quer pelo estado de saúde ou dificuldades de aprendizagem. De facto, o envelhecimento ativo e a aprendizagem ao longo da vida têm sido temas centrais da Declaração Política de Ação Internacional para o Envelhecimento de Madrid e da Organização Mundial de Saúde. Apesar de, recentemente, se ter verificado um interesse crescente na utilização de estratégias que visem responder aos desafios de uma sociedade envelhecida, grande parte dos estudos parece não considerar os jogos como estratégia de aprendizagem para motivar hábitos saudáveis, segurança e participação na sociedade.

Trinta e três alunos de uma Universidade Sénior (G0) foram envolvidos no processo de design de dois programas de aprendizagem (baseado em jogo – GBLP e assistido por computador – CALP). O trabalho de campo teve como base os seguintes métodos longitudinais: inquérito, discussões em grupo e observação participante. Sessenta alunos de quatro Universidades Sénior foram posteriormente divididos em três grupos: Grupo Experimental (G1) que testou primeiro o GBLP e depois o CALP; Grupo de Comparação (G2) que testou primeiro o CALP e depois o GBLP; e o Grupo de Controlo (G3) que não teve intervenção. Antes e pós cada experiência, foi avaliada a perceção sobre o bem-estar de saúde e qualidade de vida, utilizando as escalas SF36v2 e WHOQOL-BREF. Entrevistas semiestruturadas foram também concretizadas com dez especialistas da Academia e Indústria nas áreas dos Jogos, Interação Homem-Máquina, Psicologia e Envelhecimento, de modo a obter as suas perspetivas sobre o uso de jogos e mudanças comportamentais e envelhecimento ativo.

Os resultados sugerem que embora não tenham sido encontradas diferenças estatisticamente significativas entre grupos sobre o estado de bem-estar sobre saúde e qualidade de vida, verificaram-se diferenças entre cada grupo e perceção sobre a saúde mental ($F_{(2,57)} = 3.771$, $p = .029$) e bem-estar geral ($F_{(2,57)} = 5,231$, $p = 0,008$) em que GBLP foi eficaz em relação ao CALP. Relativamente ao design de jogos, os fatores ambiente, bem-estar mental e psicológico dos domínios de bem-estar e qualidade de vida devem ser considerados, enquanto os fatores de design como metamemória, *feedback* imediato, desafios adaptados ao contexto, narrativa e bios dos personagens, imagética e *engagement* social são importantes para aumentar a confiança dos participantes na resolução de problemas do dia-a-dia, diminuir o medo de envelhecer e incentivar a participação na sociedade. Dois protótipos que resultam das sessões de co-design são apresentados tais como um conjunto de recomendações para o seu desenvolvimento.

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keywords

digital games, active ageing, wellbeing, quality of life, learning

abstract

Current demands for the Information and Communication Society often exclude certain groups either by their age, lack of participation in the labour workforce, health status or learning difficulties. In fact, active ageing and lifelong learning have been central issues for the Political Declaration and Madrid International Plan of Action on Ageing and the World's Health Organisation. Although debate continues about the best strategies for increasing the participation of older adult citizens in economic, cultural and social affairs, few studies have addressed the potential of a game-based approach to encourage healthier habits, a sense of security and participation in society. The purpose of this mixed-method study is to assess the effectiveness of game-based learning to encourage active ageing.

In this thesis, thirty-three adult learners (G0) at a University of Third Age were involved in the design process of two learning programmes (game-based learning – GBLP and computer-assisted learning – CALP). The field research deployed an array of longitudinal methods, including surveys, group discussions, and participant observation. Sixty adult learners at four Universities of Third Age were then assigned to three different groups: The Experimental Group (G1), who tested firstly the GBLP and then the CALP; The Comparison Group (G2), who tested firstly the CALP and then the GBLP; and the Control Group (G3) that did not take part in the intervention. Before and after each experiment, the participants were assessed on their perception of health-related wellbeing and quality of life, using the SF36v2 and WHOQOL-BREF scales. Semi-structured interviews with ten Subject Matter Experts from the Industry and the Educational Sector in the fields of Games, Human-Computer Interaction and Psychology and/or Ageing studies were carried out in order to get their perspective on the use of games for learning and meet the challenges of the ageing process and changes in behaviours.

Findings suggest that although no significant differences between the type of experiment undertaken by each group and their health-related wellbeing and quality of life were observed, there were significant differences between the group type and their perception on mental health ($F(2,57) = 3.771$, $p= .029$) and general health-related wellbeing ($F(2,57) = 5.231$, $p= .008$) in which the GBLP showed improvements relative to the CALP. When designing such learning programme, the environment, mental and psychological wellbeing and quality of life domains should be considered whereas metamemory, immediate feedback, context-aware challenges, storytelling/bios and role-playing, imagery-based techniques and social engagement are important design factors to foster the participants' confidence to solve daily-life problems, decrease ageing bias and encourage participation in society. Two prototypes of the learning programmes are provided as a result of the co-design sessions and a set of design recommendations are also included.

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LIST OF ACRONYMS

ANOVA	Analysis of Variance
CARD	Collaborative Analysis of Requirements
CALP	Computer-Assisted Learning Programme
D1-PF	Domain1 - Physical Functioning
D1-PH-QoL	Domain1 - Physical Domain
D2-RP	Domain2 - Role-Physical
D2-P-QoL	Domain2 – Psychological Domain
D3-BP	Domain3 - Bodily Pain
D3-SR-QoL	Domain3– Social Relationships
D4-GH	Domain4 – General Health
D4-E-QoL	Domain4– Environment Domain
D5-Vitality	Domain5 – Vitality
D6-SF	Domain6 – Social Functioning
D7-RE	Domain7 – Role-Emotions
D8-MH	Domain8 – Mental Health
G1	Experimental Group
G2	Comparison Group
G3	Control Group
GEM	Group Elicitation Method
GBLP	Game-Based Learning Programme
GOMS	Goals, Operators, and Methods
ICT	Information and Communication Technologies
KPI	Key Performance Indicators
MTotalScore	Mental Health Total Score
NGO	Non-Governmental Organization
NTC	New Technologies of Communication
PAR	Participatory Action Research
PICTIVE	Plastic Interface for Collaborative Exploration Technology Through Video
PHTotalScore	Physical Health Total Score
UN	United Nations
URL	Uniform Resource Locator
WHO	World Health Organisation

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LIST OF ACRONYMS

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Introduction

« It [play] is our brain's favorite way

of learning and maneuvering. »

– Diane Ackerman (1999, p. 11)

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Introduction

The key research question addressed in this study is: "In what way can game-based learning affect active ageing?" The value of investigating this particular question is to understand whether game-based learning can play a crucial role in encouraging lifelong learning and demystifying ageing bias.

In today's global and learning society, peer-to-peer intergenerational networks tend to be crucial in strengthening active ageing and tackling today's economic, political and social challenges (Schmidt-Hertha, Krasovec, & Formosa, 2014).

Alongside these challenges, there has been an increase in the amount of literature published on the demographic crisis that we are currently experiencing and the policies for active ageing. As longer life expectancies and decreasing birth rates have led to growth in the ratio of the number of older adults to youngsters - almost two billion individuals aged 60 and over are expected to inhabit the world by 2050 (UN, 2002a), there is an increasingly need to re-invent strategies for sustainable active ageing and healthier lifestyles (Costa & Grist, 2017).

A number of researchers (*e.g.* Ferreira, 2010; Wahl & Mollenkopf, 2003; White et al., 1999) have emphasized the role of digital platforms in fostering wellbeing, quality of life and sense of independence in older adults. However, few studies (*e.g.* Bowling, 2008) have correlated the use of Information and Communication Technologies with the participants' perception on active ageing and inherited domains (i.e. health, sense of security and participation in society).

Debate is ongoing about the best strategies for increasing the participation of older citizens in economic, cultural and social affairs. Indeed, most of the strategies seem to

neglect the fact that game-based learning can be remarkable in providing meaningful learning experiences by linking the activity of playing, the rules and the reward systems to daily-life problems.

In addition, the proliferation of smart devices that respond to the users' context and their surrounding environment has led to an increasing interest in designing and assessing the impact of technology on daily life (Costa, Veloso, & Mealha, 2017), however, the adoption of game-based strategies and game elements to daily life has focused on its impact on illness prevention and rehabilitation (Wiemeyer, & Kliem, 2012; Pannese, Wortley & Ascolese, 2016; Leinonen, Koivisto, Sirkka, & Kiili, 2012), rather than the encouragement of activities that go beyond the health or the functional domain and that can equally have an impact on the end users' perceived wellbeing and quality of life (the ultimate goal of active ageing).

Considering the aforementioned challenges, the Human-Computer Interaction field has been evolving over the years from the mere functional to a humanistic approach that begins to embody more and more cognitive, emotional and social dynamics (Calvo & Peters, 2014; Picard, & Picard, 1997).

Hence, this research aims to assess the effectiveness of game-based learning in encouraging active ageing.

Research question and hypotheses

This section presents the research question that drives this thesis and as a mixed-method approach is followed, the questions that are the basis for each research phase (QUAL -> quant -> qual) are also presented (as recommended by Creswell, 2013). These research questions were expected to meet the quality criteria of clarity, feasibility, answerability, relevance and ethics (Quivy & Van Campenhoudt, 1998).

The key research question in this study is "In what way can game-based learning affect active ageing?" The value of investigating this particular question is to understand whether game-based learning can play a crucial role in encouraging lifelong learning and demystifying ageing bias. The rationale for investigating this question is also based on the following assumptions:

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- Games can have therapeutic effects (cognitive, physical and psychological, among others) and help to cope with pain (Ceranoglu, 2010; Costa & Veloso, 2016a; Griffiths, Kuss, & De Gortari, 2013; Roepke et al., 2015);
- There are a number of studies that show the effectiveness of games in fostering intercultural communication (Guillén-Nieto & Aleson-Carbonell, 2012), factual knowledge and learning achievements (Wong et al., 2007); training information processing speed, attention, mental set shifting and problem-solving (Schott, 2011); and encouraging health-related behaviours (Baranowski, Buday, Thompson, & Baranowski, 2008).

In order to answer the research question, the following sub-questions and hypotheses were formulated (divided into the phases PHASE 1: The research question answered by the *participatory action qualitative research*; PHASE 2: The hypotheses answered by the *quantitative experimental research;* and PHASE 3: The research question answered by the *mixed-method research*):

PHASE 1: The research question that is answered by the *participatory action qualitative research*

- What are the design components that a digitally-mediated learning programme should have for affecting active ageing?

PHASE 2: The hypotheses that are answered by the *quantitative experimental research*

Three different groups were assigned to different experiments in order to assess the effectiveness of game-based learning in comparison to other digitally-mediated approaches (i.e. video-based Computer-Assisted Learning Programme- CALP). The groups were divided as follows: The Experimental Group (G1), that tested firstly a Game-Based Learning Programme (GBLP) and then a Computer-Assisted Learning Programme (CALP); The Comparison Group (G2), that tested firstly the CALP and then the GBLP and the Control Group (G3) that did not take part in the intervention.

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Hence, the following hypotheses were formulated:

- H_0: There are no significant differences between the type of the experiment undertaken by each group (G1, G2 or G3) and their perception on health-related wellbeing and quality of life;

- H_1: There are significant differences between the type of experiment undertaken by each group (G1, G2 or G3) and their perception on health-related wellbeing and quality of life.

PHASE 3: The research question that is answered by the *mixed-method research*

- How do the design components of the learning programmes mentioned by the adult learners (G0) help to explain the influence of game-based learning on the adult learners' health-related wellbeing and quality of life?

Purpose of the study and main goals

This study addresses the way game-based learning can affect active ageing. The purpose of this mixed-method study is to develop two learning programmes (Game-Based Learning Programme – GBLP and Computer-Assisted Learning Programme- CALP) that meet the adult learners' needs and affect their health-related wellbeing and quality of life.

The initial phase of the study was a qualitative participatory action research in which a group of adult learners (G0) was involved in the design process of both learning programmes. From these co-design techniques, qualitative findings were the basis for developing the learning programmes that serve as experiments to be implemented in an experimental research design administered to a large sample (G1 and G2).

In the quantitative phase, the adult learners' perceived health-related wellbeing (SF36v2) (Maruish, 2011) and quality of life (WHOQOL-BREF) (WhoQol Group, 1998) were assessed before and after each experiment. Meanwhile, the following goals were outlined for each phase of the research project:

1) PHASE 1: The goals addressed by the *participatory action qualitative research*;

2) PHASE 2: The goals addressed by the *quantitative experimental research*;

3) PHASE 3: The goals addressed by the *mixed-method research*.

The main goal answered by the PHASE 1 - *participatory action. qualitative research* was:

General: Understand the main design components that a learning programme should have for encouraging active ageing;

Specific:
- Involve a group of adult learners (G0) in the design process of the learning programmes (GBLP, CALP) through the use of brainstorming sessions and co-design techniques;
- Develop the Game-Based Learning Programme (GBLP) and the Computer-Assisted Learning Programme (CALP);
- Identify the functional and technical requirements with the co-design group (G0);

The main goal answered by the PHASE 2 - the *quantitative experimental research* was:

General: Assess the effectiveness of a game-based learning programme for encouraging active ageing in comparison with a computer-assisted learning programme;

Specific:
- Conduct both learning programmes (GBLP for the Experimental Group – G1; CALP– Group of comparison – G2);
- Assess the participants' wellbeing and quality of life before and after experiment;
- Compare, analyse and interpret the results obtained.

The main goal answered by the PHASE 3 - *mixed-method research* was:

General: Understand the way the design components of the learning programmes mentioned by the adult learners (G0) help to explain the influence of the determinants of health-related wellbeing and quality of life in the design of a game-based learning strategy;

Specific:
- Provide a set of guidelines to develop game-based learning programmes for affecting active ageing.

The analysis model

This analysis model has the purpose of facilitating the selection of the research method and the instruments used for data collection. The model (Table 01) is based on the research question – "In what way can game-based learning affect active ageing?" and the relationships established between the independent (game-based learning) and dependent variables (active ageing) (Figure 01) as well as the main project-based concepts, dimensions, indicators and scales were formulated (Quivy & Van Campenhoudt, 1998).

Figure 01. The relationship between the variables of the research question

To start with, the key terms are defined as follows. The definitions and policies of Active Ageing were used in the World Health Organization's report on Active Ageing (World Health Organization, 2002):
- Active ageing: "[…] the process of optimizing opportunities for health, participation and security in order to enhance quality of life as people age." (World Health Organization, 2002, p. 12)

- Health: "[…] physical, mental and social wellbeing." (World Health Organization, 2002, p. 51)

- Security: "When policies and programs address the social, financial and physical security needs and rights of people as they age, older people are ensured of protection, dignity and care in the event that they are no longer able to support and protect themselves. Families and communities are supported in efforts to care for their older members." (World Health Organization, 2002, p. 46)

- Participation: "When labour market, employment, education, health and social policies and programmes support their full participation in socioeconomic, cultural and spiritual activities, according to their basic human rights capacities, needs and preferences, people will continue to make a productive contribution to society in both paid and unpaid activities as they age." (World Health Organization, 2002, p. 46)

The definition of Affect was based on the work of Damásio and Spinoza (Damasio, 2003, p. 316):

- Affect: Damásio acknowledges the work of Spnioza to define Affect as the "[…] modifications of body, whereby the active power of the said body is increased or diminished, aided or constrained, and also the idea of such modifications" (Spinoza, The Ethics, Part III)]." Drawing on this Spinoza's definition, Damásio also adds that the concept of affect embodies the use of emotions and feelings.

The definition of Digital Game-based learning was based on the work of Prensky. Hence, game-based learning is defined as "Any marriage of educational content and computer games" (Prensky, 2001, p. 145)

This research project follows a mixed-method approach (explained in detail in Chapter 5, devoted to the Empirical Study). Therefore, the following hypotheses are related to the Quantitative phase (The Experimental Study) whereas the expected results are related to the Qualitative phase:

- Hypotheses:

H_0: There are no significant differences between the type of the experiment undertaken by each group (G1, G2 or G3) and their perceived health-related wellbeing and quality of life;

H_1: There are significant differences between the type of experiment undertaken by each group (G1, G2 or G3) and their perceived health-related wellbeing and quality of life.

- Expected result: Game-based learning programmes are expected to facilitate the attribution of meaning to the knowledge transmitted and produced. As they tend to be goal-oriented activities, the players are likely to anticipate the intended results (Tversky et al., 2003) and thus reinforce the interaction between mental and psychomotor operations. Games can function as 'a call to action' for encouraging active ageing and healthy lifestyles by leading to pro-active attitudes and providing immediate feedback (sense of reward) and triggering successive increases and decreases in the brain activity (simultaneous sense of arousal and calm). The release of dopamine in the players' brain also seems to give a sense of pleasure that can restore hemodynamic responses of the brain. Indeed, the roadblocks of behaviours and automatically responses – pain and pleasure (Damasio, 2003) tend to be stimulated during the game-activity by successive challenges, rewards and punishments.

The expected results of the qualitative research phase are:
- Successfully involve the adult learners in the design process of both learning programmes – Game-Based Learning Programme (GBLP) and Computer-Assisted Learning Programme (CALP);
- Have functional prototypes; and
- Understand the main design components to develop effective Game-Based Learning Programmes (GBLP) to affect active ageing.

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Table 01. The analysis model based on Quivy & Van Campenhoudt, (1998)

Concepts	Dimensions	Indicators	Scale
Active ageing	Health	Physical wellbeing Cognitive wellbeing Social wellbeing Nutrition	Wellbeing, Quality of Life, Routines related to nutrition, physical, cognitive and social activities
	The sense of security	Security Dignity Rights	Legislation (older adults' rights) Priorities in human security
	Participation in Society	Participation in social and civic affairs	Level of citizenship engagement, Voluntary work, Participation in social movements or associations, Participation in cultural heritage, Contribution to the creative sectors
Affect	Emotional responses	Background emotions, Primary emotions, Social emotions	State of being (good/bad); Fear, Anger, Disgust, Surprise…; Sympathy; Shame; Gratitude; Envy…
	Feelings	Perception of a certain body and mind state	Empathy, pleasure, joy, delight, sorrow, wellbeing…(PANAS scale)
	Affective design in game context	Player experience Game flow	Information, interaction, visual design, level of concentration, perception of time, deep enjoyment
Game-Based Learning (GBLP)	Learning	Information	Learning goals, game activities, learning to play, learning theories, literacy, readability of signs and symbols

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My personal motivations

This study was inspired by the research carried out in my MSc in Multimedia Communication (Costa, 2013) and my involvement in the SEDUCE research project (Senior citizen use of computer-mediated communication and information in Web Ecologies - PTDC/CCI-COM/111711/2009).

During my Master's thesis, I have carried out a survey with 245 gamers aged 50 and over and two focus groups in order to understand the main design components of networked video games that encourage older adults to play. The study has revealed that cognitive challenges are valued and problem-solving and memory span are the skills that participants prefer to practice.

Moreover, the enthusiasm expressed by both gamers aged 50 and over and the participants of the research project SEDUCE[1] when playing games has motivated me. For many of them, games had a therapeutic effect by being cognitively challenged and rewarded. Others have reported that the game industry was not fulfilling their truly motivations and accessibility.

I was also involved in the design of games of the online social community miOne[2] that had the purpose of training the players' memory skills, attention, logical reasoning and strategy.

Finally, I believe that game-based learning can facilitate the process of attributing meaning to information and thus, be a suitable medium to learn, encourage pro-active attitudes; and trigger healthier habits and a positive perception towards the ageing process.

The thesis proposal structure

This thesis is divided into 8 Chapters, including Introduction and Conclusions. From Chapter 1 to Chapter 4, the literature on the general aspects of active ageing, learning environments, game-based learning and the use of technologies for wellbeing and quality of life are reviewed. Chapter 5 covers the methods used whereas Chapter 6 presents the results.

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[1] SEDUCE research Project: www.seduce.pt/SITE_EN/ (Access date: Oct 27th, 2017)
[2] miOne online community: www.mione.pt (Access date: Oct 27th, 2017)

Chapter 1 is devoted to Active Ageing. It presents the differences between the concepts of healthy, successful and active ageing; previous studies on wellbeing and quality of life in older adults; the implications of ageing well in the Information and Communication Society and the problem of ageism, techno-ageism and game-ageism.

Chapter 2 gives a brief overview of the Meaningful learning environments for active ageing. This Chapter covers the process of learning and the skills acquisition at a later age, adult education and distance learning.

Chapter 3 looks at the differences between Game-based learning and Serious Games. It also introduces the concept of *Gamification* and puts it into the context of learning.

Chapter 4 covers the design process of technologies for wellbeing and quality of life (emotional and behavioural design, proxemics in smart game-playing and the co-designing process).

Chapter 5 is concerned with the Method used. Specifically, the procedures undertaken in a mixed-method approach, the origins and rationale for carrying out this type of research, an overview of the phases, activities, methods and instruments for data collection used in the research; information relative to the qualitative phase – Participatory Action Research (setting and data collection, information about the participants, and the role of the researcher), information about the quantitative phase – Experimental design (setting and data collection, information about the participants, measures and analysis); and information relative to the qualitative phase – Interviews (the interview questions, information about the interviewees and the interview protocol). Finally, the ethical issues are discussed.

Chapter 6 analyses the results of the learners' wellbeing and quality of life before, during and after the experiment. The results encompass the initial assessment of the participants' contexts of the co-design group, the two prototypes that were developed and resulted from the co-design sessions and both the psychological and design factors that should be taken into account when designing and assessing the digitally-mediated platforms and recommendations to develop a game-based learning strategy.

The resulting research is supported by the Foundation for Science and Technology (SFRH/BD/101042/2014).

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1 "ACTIVE AGEING"
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1 "Active ageing"[3]

« How old would you be

if you forgot your age? »

– Satchel Paige (as cited in Butler, 2005a, p. 63)

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[3] Part of the content of this Chapter has been published in the following papers:

Costa, L., & Veloso, A. (2015). "The gamer's soul never dies: Review of digital games for an active ageing". In *Proceedings of the 2015 10th Iberian Conference on Information Systems and Technologies, Aveiro, 17-20 June 2015*. Ed. Rocha et al. USA: IEE, 2015. Doi: https://doi.org/10.1109/CISTI.2015.7170614

Costa, L. & Grist, H.(2017). Ageing in a network society: An Introduction. *Networking Knowledge: Journal Of The MeCCSA Postgraduate Network, 10*(1), 1-4. Retrieved from http://ojs.meccsa.org.uk/index.php/netknow/article/view/499 (Access date: Oct 27th, 2017)

Costa, L., & Veloso, A. (2016). Being (Grand) Players: Review of Digital Games and their Potential to Enhance Intergenerational Interactions. *Journal of Intergenerational Relationships*, *14*(1), 43-59. Doi: Doi: https://doi.org/10.1080/15350770.2016.1138273

Costa, L. V., & Veloso, A. I. (2016). "'Game-based psychotherapy' for active ageing: A game design proposal in non-game context". In *Proceedings of the TISHW 2016 - 1st International Conference on Technology and Innovation in Sports, Health and Wellbeing, Vila Real, 1-3 Dec. 2016*, USA: IEE 2016, 1-8. Doi: https://doi.org/10.1109/TISHW.2016.7847788

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1 "Active ageing"

This Chapter presents the differences between the concepts of healthy, successful and active ageing. Previous studies on wellbeing and quality of life in older adults are also covered, as well as the implications of ageing in the Information and Communication Society with the problems of ageism, techno-ageism and game-ageism.

1.1 The concepts of healthy, successful and active ageing

According to the Organization for Economic Co-Operation and Development (OECD Publishing, 2000, p. 126), 'active ageing' refers to:

> *"[...] the capacity of people, as they grow older, to lead productive lives in society and the economy. This means that people can make flexible choices in the way they spend time over life – learning, working, and partaking in leisure and giving care."*

However, a major criticism of this definition is that it is too focused on the role of older adults in production and participation in society. Therefore, some authors (e.g. Ranzijn, 2010; Ribeiro, 2012; Van Dyk, Lessenich, Denninger, & Richter, 2013) question the use of the term "active ageing" and they have been adopting other alternatives as "healthy ageing" or even "successful ageing" that were used by such authors as Pfeiller (1974, as cited in Walker, 2002) and Rowe and Kahn (1997). The following is a brief report on the definitions and flaws on using the different concepts.

A. The concept of healthy ageing

In broad medical and nursing terms, "healthy ageing" is generally understood as the result of the increasing age in mortality, the absence of chronic illnesses, decreasing morbidity and good functional status (Hansen-Kyle, 2005).

Although this definition has been amended to embody the notion of wellbeing and quality of life, it is likely to be in need of revision since the ageing process is not only biological but also psychological and social.

B. The concept of successful ageing

The concept of "successful ageing" is frequently used in the literature (Baltes & Baltes, 1993; Lee, Lan, & Yen, 2011; Rowe & Kahn, 1997). This term dates back to the 60s with the meaning of "adding life to the years." (Martini, Garrett, Lindquist, & Isham, 2007, as cited in Lee et al., 2011, p. 211).

According to Rowe and Kahn (1997), successful ageing encompasses the following characteristics: (a) low probability of diseases; (b) increase in functional capacity; and (c) life engagement. Although this term includes the assumptions for independent living, satisfaction and quality of life (Bowling, 1993, 2005; Lee et al., 2011), the term 'success' may have a materialistic connotation by being associated with status and achievement (Peel, Bartlett, & McClure, 2004).

B. The concept of successful ageing

As mentioned earlier, the concept of "active ageing" has also been subjected to considerable criticism. According to Van Dyk, Lessenich, Denniger and Richter (2013), it emphasizes the usefulness of the older adults' activities to the society and the passive image of retirement.

Although the key problem with this concept is its relatedness with the activity theory, the concept of active ageing will be used in this thesis. Indeed, the term activity is not only related with the capacity of human beings to be agents in society but also with health (physical, cognitive and social activities), sense of security and quality of life.

This study will use the definition proposed by the World Health Organization (2002, p. 12):

> *"Active ageing is the process of optimizing opportunities for health, participation and security in order to enhance the older adults' quality of life as people age."*

In an analysis of the WHO framework (2002) for active ageing, the three pillars adopted were: health, security and participation in society. Moreover, the activity theory model (Figure 02) also applies to this thesis in the sense that the individual has an aim (perceive a better health, sense of security and participation in society).
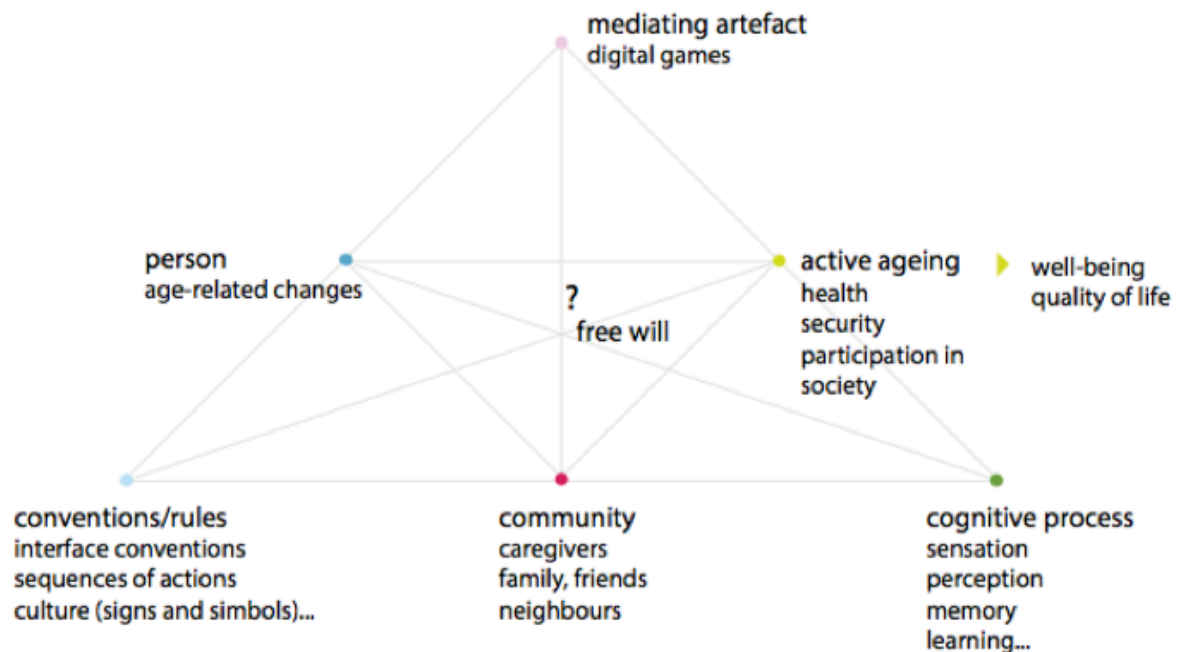
Figure 02. The activity theory applied to this study (Costa & Veloso, 2015)

As shown in Figure 02, the community, the conventions used and the cognitive processes (sensation and perception) also influence the path to attain one's aim. Finally, a mediating artefact affects and helps to attribute meaning to experience towards someone's aim or ultimate goal.

In this model, free will has been added with a question mark as a response to the criticism that the activities are pre-determined and influenced by society or cultural values. However, it is questionable if free will really exists in any circumstance.

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Caution, though, must be applied in this study, as the WHO framework for active ageing has not yet been validated (Paúl, Ribeiro, & Teixeira, 2012). Therefore, in this study, the variables of sense of wellbeing and quality of life have also been contemplated.

1.1.1 Living healthier for longer

Living healthier for longer seems to be one of the most important principles of active ageing. During the ageing process, there is often a decline in the physical function, mainly in the senses of sight, hearing and balance (Fisk, Czaja, Rogers, Charness, & Sharit, 2009; Haegerstrom-Portnoy, Schneck, & Brabyn, 1999). Thus, training is fundamental to maintain some of the body functions and to stimulate the brain plasticity.

The World Health Organization (2002, p. 12) defines Health as "the physical, mental and social well-being." As it is highlighted in this definition, it is not only the physical factor that is important for a good health but also the cognitive and social aspects. Therefore, physical activities, nutrition, cognitive training and social interactions are crucial in determining the adoption of healthier lifestyles.

A. Physical exercise

Physical exercise play a vital role in overcoming and preventing the risk of certain diseases – *e.g.* hypertension, diabetes and cholesterol (Stewart, 2005; Van Norman, 2010; World Health Organization, 2015a). In addition, there has been a growing interest in preventive medicine over the years and social support networks are now being recognized as determinant elements for stimulating physical exercise (Ashton, Grey, & Barnard, 1986).

Body movement and the energy expenditure also prepare the organism for adaption to environmental changes, defence, survival and action (World Health Organization, 2015a). In fact, some of the benefits for practising physical exercise are (Santos & Knijnik, 2009, p. 25; World Health Organization, 1996):

- Prevent health problems;
- Strengthen the muscles;
- Improve agility and posture;
- Prevent excessive weight gain;
- Prevent cardiovascular diseases, osteoporosis and diabetes;

- Reduce the risk of fracture and the frequency of falls;

- Reduce depression and anxiety;

- Improve the stress tolerance;

- Improve sleep and mood;

- Maintain and improve mobility;

- Improve cognitive and brain function;

- Increase confidence.

Nonetheless, a strong motivation is necessary in order to change behaviours and achieve the benefits of physical exercise (Biddle & Mutrie, 2007). A motivation may be defined as the way entities or events trigger stimuli, aiming at influencing certain behaviour (Keller, 2009, p. 31). Figure 03 illustrates the cycle of change proposed by Prochaska and DiClemenet (2005) adapted to the physical activity (Biddle & Mutrie, 2007).
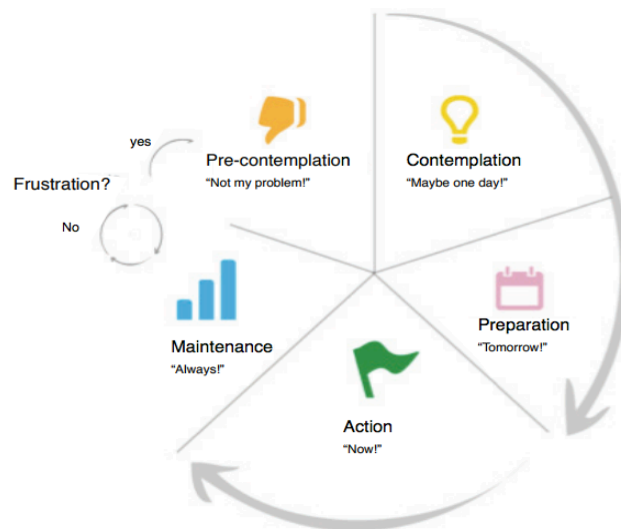
Figure 03. Cycle change proposed by Prochaska and DiClement (2005)

As shown in Figure 03, the cycle of change is divided into the following phases:

1. *Pre-contemplation*: This is the first phase of the model. The individual is not interested in changing behaviours and denies every problem (e.g. sedentary lifestyle, lack of physical exercise). In this phase, it is necessary to inform the individual about the benefits of the physical activity;

2. *Contemplation:* In this phase, the individual's willing to do exercise is not transferred into practice. The pros and cons of the activity are measured and in

some cases, the search for the availability of programmes for physical exercise is initiated;

3. *Preparation:* In this phase, the main objectives and actions are planned in order to be accomplished during the following days;

4. *Action:* In this phase, there is a modification of the behaviours. Information on strategies for maintaining this modified behaviour and routine is necessary for encouraging healthier lifestyles.

5. *Maintenance:* In this phase, there is a constant concern to maintain the physical exercise as part of the routine. New exercises and changes in the intensity are necessary to maintain physical habits.

To summarise, these phases of the cycle of change have a great impact on the design of a training program that takes into account the individuals' motivations and context. In addition, exercise frequency is often relevant to maintain new routines.

B. Nutrition

Nutrition is a growing public concern worldwide (Ahmed & Haboubi, 2010; Berdanier, Dwyer, & Feldman, 2007; World Health Organization, 2003, 2015b). Indeed, longevity and the avoidance of certain diseases (e.g.: colon cancer, high blood pressure, diabetes) are dependent on the dietary intake (Brandao, Pimentel, Silva, & Cardoso, 2008; Dangour, Grundy, & Fletcher, 2007).

Food is composed of substances known as nutrients, which are necessary for building the body tissues and producing energy (Berdanier et al., 2007). On the one hand, good nutrition can reduce the exposures to certain diseases but, on the other hand, the lack or abundance of certain nutrients can generate malnutrition, obesity, and irregularities in cardio-respiratory, gastrointestinal or muscle functions (Ahmed & Haboubi, 2010; Brandao et al., 2008; Dangour et al., 2007; World Health Organization, 2003, 2015b).

C. Cognitive training

The ageing process is also associated with cognitive changes either functional or chemical. In fact, the brain is a complex organ that functions as a muscle and it is changeable (Goldstein, 2014; Mason, 2017).

Recent research findings (Goh & Park, 2009; Park & Bischof, 2013) have revealed that neuroplasticity occurs with cognitive training. In other words, the brain is adaptable and changeable like plastic by forming new neural connections and weakening others in accordance with the individual's brain activities.

Moreover, learning experiences can change the nervous system and the way information is processed and transmitted in order to make decisions (Goldstein, 2014; Mason, 2017). Therefore, it is suggested in this thesis that game-based learning has a great potential for providing meaningful learning experiences and facilitating the process of attributing meaning to the information provided, with the purpose of rewiring the brain for a change – i.e. encouraging healthier behaviours and lifestyle.

By contrast, the ageing process is often accompanied by a decrease in certain cognitive functions that may influence the quality of life. The skills affected seem to be the perceptual speed, memory, visual-perceptual functions and verbal and numerical skills (Pires, 2011). Hence, game designers should also be aware of these cognitive effects of the ageing process and its implications for game design (Costa, 2013).

Overall, brain fitness games are essential for training memory, processing speed, and attention, among other capacities and, thus, contribute to the brain's plasticity and neural flexibility that tends to be maintained throughout later life (Schaie & Willis, 1986, as cited in Aison, Davis, Milner, & Targum, 2002).

D. Social interactions

Social interactions are also central to the concept of active ageing (World Health Organization, 2002). The term interaction refers to a communal action that occurs between two or more agents, who influence each other (Oxford dictionaries, 2015). In *The Nature of Social Action*, the author Max Weber (1978) draws our attention to the fact that the agents simultaneously attribute meaning to one's actions on particular occasions. This interdependence between "myself" and the "others" exposed by Weber leads to the cycle

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illustrated in Figure 04, in which the individual's mind-set is shaped by the ideal self and the individual's cultural repertoire, based on the studies of Bateson (1972), Cooley (2009) and Goffman (2005).

The author Charles Cooley had already discussed the congruence between the self and the others in 1902 (Cooley, 1992; Cooley & Mead, 2006). He has had introduced the looking glass self-concept (Cooley, 1992; Cooley & Mead, 2006), in which the author defended that the self was a three-step process product of social interactions: (1) We imagine how others see us; (2) We imagine how others are judging us and; (3) We react accordingly. Therefore, the way the self is presented to the others would be also fundamental to this process and according to Goffman (2005), self-identity tends to be ubiquitous and shaped by the patterns (norms, religion, values, etc.) imposed by society.
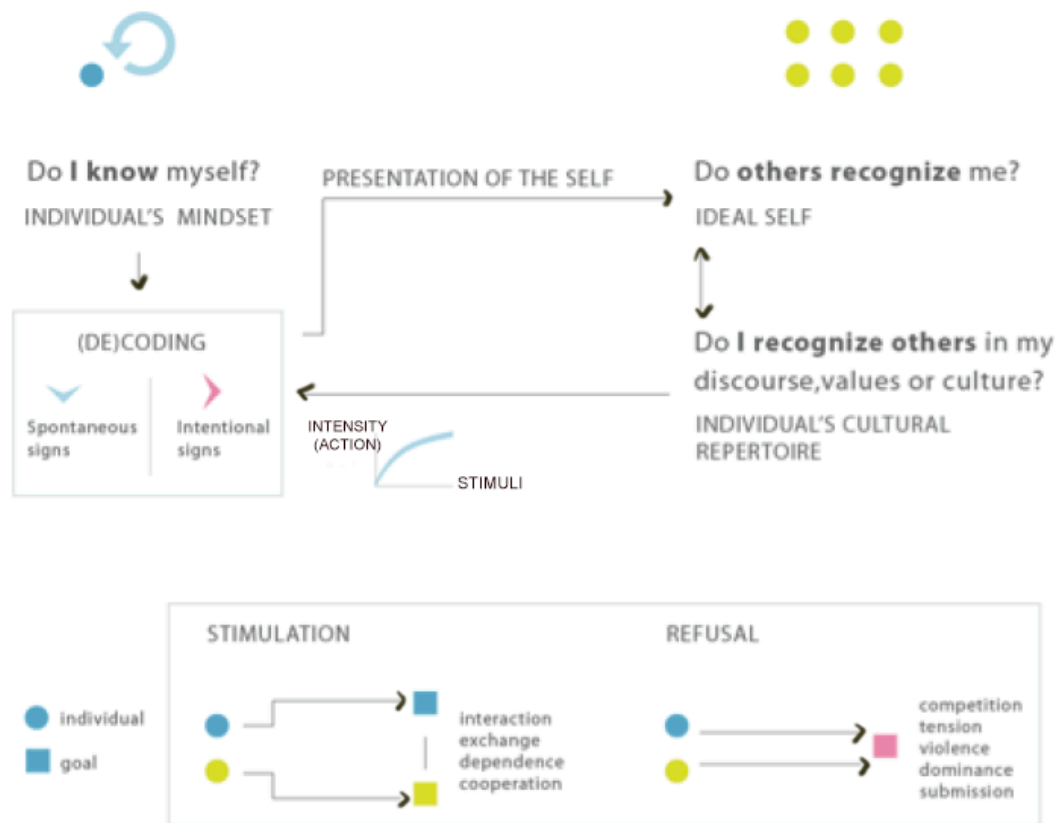
Figure 04: Social interaction scheme - Bateson (1972),Cooley (2009) and Goffman (2005)

For Bateson (1972), the mentioned patterns connect individuals and unfold the way the world is perceived in an ecological system.

In addition, if a group of individuals have different but complementary goals, the interaction is likely to be of dependence, exchange or cooperation. By contrast, if the group has the same goal, their interactions are expected to be limited to competition, tension, violence, dominance or submission. Hence, there is a need to achieve an equilibrium between the self and the others' action or response and the intensity of the action is also related with the intensity and frequency of the stimuli.

In brief, self-knowledge ('Know thyself') (Ryff & Keyes, 1995) is influenced by the cycle that is established between the ideal self, the individual's mind-set and the individual's references and cultural repertoire (Bateson, 1972; Cooley, 2009; Goffman, 2005). The quality of these interactions between the self and the others seem to be dependent on (a) how much I know myself; (b) how much others recognize me; and (c) how much I recognize others in my discourse, values or culture.

1.1.2 The sense of security at a later age

According to the WHO (2002), security is one of the key variables that define active ageing. In general, societies play a vital role in ensuring the individual's safety, security and dignity and thus, contributing to the formation of a nation without fear and with self-esteem and quality of life (United Nations, 2009). Knowledge on the importance of human security, its definition, types of human security and the human rights of older adults is discussed below.

A. The concept of human security

The term 'Human Security' has been changing over time (UN, 2009). Based on the concepts of liberty, dignity, equality, solidarity, tolerance and respect, human security has been applied to different contexts – politics, finance, economics and environmental (WHO, 2002; UN, 2009).

For the UN Human Security Office for Coordination of Human Affairs (UN, 2009, p.6), human security refers to:

> "(…) protecting people from critical (severe) and pervasive (widespread) threats and situations. It means using processes that build on people's strengths and aspirations. It means creating political, social, environmental, economic, military,

and cultural system that together give people the building blocks of survival, livelihood and dignity."

In the same vein, the World Health Organization (2002, p.5) defines security as the "social, financial and physical security needs and rights of people as they age."

B. *Types of human security*

The following principles on human security were identified in the UN Agenda in order foster 'freedom from fear', 'freedom from want' and 'freedom to live in dignity' (UN, 1994):

a. People-centred (promote human dignity, advances in economic, culture and social issues);

b. Multi-sector (e.g. security in economy, food, health);

c. Comprehensiveness (encourage comprehensive and multi-sector responses to problems and the collaboration between citizens);

d. Context-specific (local and national contexts);

e. Prevention-oriented (imply the change in behaviours, aiming at reducing the effects of possible threat).

Finally, some of the contexts in which human security can be applied (UN, 1994) are: Threats to survival; Threats to subsistence; Threats to human dignity; Threats to economy (poverty, unemployment…); Threats to health (infectious disease, food insecurity, lack of access to basic healthcare, malnutrition…); Threats to environment (pollution, natural diseases, environment degradation, lack of natural resources…); Threats to personal security (physical violence, crime, terrorism, domestic violence, labour exploitation); Threats to community (ethics, religion…); and Abuse of Human rights.

C. Human rights of older adults

Human Rights are international laws that aim to address injustices and conflicts in society. These rights are fundamental to the Human being and meet the following principles (United Nations Population Fund, 2005):

a. Universality and inalienability: These rights are part of the International Law and can't be sold, negotiated or removed;

b. Interdependence and indivisibility: The rights are interrelated and interdependent;

c. Equality and non-discrimination: The rights are extended to everyone and any discrimination is forbidden. This principle is reflected in the Article 1 of the Universal Declaration on Human Rights: "All human beings are born free and equal in dignity and rights."

In the past few years, many challenges regarding the human rights of older adults are brought with an ageing society (e.g. freedom from discrimination, equal opportunities at work). Although these challenges have been previously discussed in the Madrid Declaration and International Plan of Action on Ageing, they had no visibility in the International scale. Thus, a set of human rights of older adults were published. These were the rights (UN, 2011):

- The right to freedom from discrimination (access to goods and services, regardless of the individuals' age, gender, physical or mental condition);

- The right to freedom from violence;

- The right to social security (e.g. lack of social protection – pensions, risk of poverty);

- The right to health (healthcare);

- The right to property and inheritance rights;

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- The right to continuing education (learning programmes, vocational training, lifelong learning, social networks…);

- The right to participate in political and cultural decisions, to work and have access to justice.

Collectively, both the different types of human security and the Human rights of older adults are fundamental for the perception of active ageing and thus, they will be covered in the learning programmes.

1.1.3 The sense of citizenship and participation in society

Another area of intervention for active ageing is the older adults' participation in society (WHO, 2002). In fact, one of the World Health Organization's policies (2002, p.51) aims to:

> *"(…) recognize and enable the active participation of people in economic development activities, formal and informal work and voluntary activities as they age, according to their individual needs, preferences and capacities."*

Having said that, initiatives that include the individuals in planning, implementation and evaluation of economic, political and socio-cultural decisions are increasingly in demand. Indeed, there are a number of policies of intervention, in which individuals can participate such as:

A. *Human development and social intervention policies*
B. *Intervention policies in the environment*
C. *Intervention policies in education*
D. *Intervention policies in health*

A. *Human development and social intervention policies*

In the human development report (United Nations Development Programme, 1990, p.1), the term usually refers to:

"the process of enlarging people's choices. The most critical ones are to lead a long and healthy life, to be educated and to enjoy a decent standard of living. Additional choices include political freedom, guaranteed human rights and self-respect."

Although other concepts have been introduced since then in order to reinforce the participatory process, its basis continues to be people's choices and the ultimate goals of improving self-esteem and quality of life. Hence, the millennium development goals are published every year by the United Nations in order to contribute and assure Human development in different countries (Waage, Banerji, Campbell, et al., 2010).

B. *Intervention policies in the environment*

In terms of the intervention policies in the environment, the United Nations Environment Programme (n.d.) defined the following priorities: Response to climate changes; Response to disasters and conflicts; Ecosystem management; Chemicals and Waste; and Resource efficiency.

In response to these priorities, one may suppose that the development of open-access platforms to support communities of environmental practices should be encouraged. Indeed, Information and Communication Technologies can: (a) inform the individuals about the current problems and environmental policies; (b) simulate current and future scenarios that result from different actions and policies; and (c) help to support the individual's decision on the physical world. Another way to participate in society can be done through education and learning.

C. *Intervention policies in education*

Education can exert a powerful effect upon the individual's participation in society and the contribution to the human development.

According to UNESCO (2011), some of the strategies for improving adult education are: (a) Ensuring that the adult learners' needs are being met with the learning programmes; (b) Encouraging vocational training programmes and post-literacy initiatives; and (c) Interconnecting formal, non-formal and informal learning. Similarly, the Hamburg Declaration on Adult Learning (UNESCO, 1997) has been created in order

to set out the agenda for the future of adult education. This agenda embodies the following principles:

1. Adult learning and democracy: the challenges of the twenty-first century;
2. Improving the conditions and quality of adult learning;
3. Ensuring the universal rights to literacy and basic education;
4. Adult learning, gender equality and the empowerment of women;
5. Adult learning and the changing world of work;
6. Adult learning in relation to the environment, health and population.

As adult learning is a central topic of this thesis, a more thorough discussion is provided in Chapter 2. Meaningful learning environments for active ageing.

D. Intervention policies in health

In the case of the intervention policies in public health, the challenges of a global world cover the following major causes of death in the worldwide (WHO, 2014): Ischaemic hearth disease; Stroke; Chronic obstructive pulmonary disease; Lower respiratory infections; Trachea, bronchus, and lung cancer; HIV/AIDS; Diarrhoeal diseases; Diabetes mellitus; Road injury; and Hypertensive heart disease.

Preventing these diseases and helping others to overcome and prevent them is also crucial for encouraging active ageing. Hence, these have been addressed in order to cover the dimensions 'health' and 'participation in society' that embody the concept of active ageing.

1.2 The concepts of wellbeing and quality of life

Recently, there has been a renewed interest in wellbeing and quality of life (e.g. Bond & Corner, 2004; Bowling, 2005; Brooks, Brahnam, & Jain, 2014; Kirkwood & Cooper, 2014). In fact, different countries have brought to the fore their concerns regarding wellbeing and quality of life since these variables have been perceived to influence health development, life expectancy and economic and social progress.

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In April 2012, the United Nations and the Royal Government of Buthan (Royal Government of Bhutan, 2012) have proposed a New Economic Paradigm, in which Human happiness and wellbeing were key to society's progress and the development of countries.

Therefore, this section provides a brief overview of the concepts and the instruments used for assessing wellbeing and quality of life.

1.2.1 The concept of wellbeing

For centuries, ageing and wellbeing have surprisingly aroused the interest of humankind. Although a number of philosophers have already discussed the concepts of happiness (*e.g.* Aristotle) and contributed to the theories of wellbeing (*e.g.* Hedonism introduced in Plato's Protagoras) in the 18th century, the people's wellbeing and longevity have become some of the major concerns of society. The publications "An essay of health and long life" (Cheyne, 1724) or "Domestic Medicine" (Buchan, 1848) are some examples.

In the Introductory part of "An essay of health and long life," Cheyne (1724, p.1) writes:

> *"It is a common Saying, That every Man past Forty, is either a Fool or a Physician. It might have been as justly added, that he was a Divine [i.e. clergyman] too: For, as the World goes at present, there is not any Thing that Generality of the better Sort of Mankind so lavishly and so unconcernedly throw away, as Health, except externally Felicity. Most men know when they are ill, but very few when they are well. And yet it is most certain that 'it is easier to preserve Health, than to recover it; and to prevent Diseases, than to cure them."*

This quotation reflects the primary concerns regarding welfare, retirement and wellbeing that have emerged during the industrial revolution. Wellbeing, at that time, took part of a "take-care-of-yourself movement." In other words, the statement suggests that population should cultivate their own wellbeing in later life.

Although Cheyne's essay focuses on health-related factors for increasing longevity, we can see that there is still a degree of uncertainty around the concept of wellbeing (*e.g.* Most men know when they are ill, but very few when they are well"). Similarly, a general accepted definition of the term is still lacking in today's society.

Indeed, there are different variables that are suggested to define wellbeing instead of a clear definition. On reason for the use of different variables to characterize wellbeing may be due to the acceptance of objective lists over some theories of wellbeing (i.e. hedonism or desire theories (Kirkwood & Cooper, 2014).

Table 3 shows the description and criticism for different theories of wellbeing based on a study of Kirkwood and Cooper (2014).

As can be seen from Table 02, the different theories of wellbeing present a number of flaws. However, the objective list theories are the ones that predominate in the attempts for defining and measuring wellbeing.

Table 02. Different theories of wellbeing

Theories	Hedonism	Desire theories	Objective list theories
Brief description	The individual's wellbeing is dependent on the balance of pleasure over pain	The individual's wellbeing is dependent on the satisfaction of their desires or preferences	List items that characterize wellbeing
Criticism	The experience machine scenario: A repeated pleasant activity may not be ideal and not bring meaningful experiences	Pleasurable experiences that are not part of own desire fulfilment can contribute to the individual's wellbeing	Elitism (items may not be applied to all individuals)

For example, there are six components that define wellbeing according to Ryff and Keyes (1995): autonomy, environmental mastery, personal growth, positive relatedness to others, a sense of purpose in life, and self-acceptance. Although these factor-related definitions often fail to recognize the heterogeneity of the population, there is more emphasis on the current contexts of individuals.

Other authors (e.g. Diener, Suh, Lucas, & Smith, 1999) define wellbeing as cognitive process during which individuals reflect on their experiences (comparing the frequent and

positive experiences with the frequent and negative ones). In addition, Kirkwood, Bond, May, McKeith and Teh (2010) ascertain that wellbeing and mental capital vary across different life stages.

Collectively, these studies show that general well-being is characterized by both subjective wellbeing (e.g. self-reported feelings) and objective wellbeing (e.g. experiences and education that takes place throughout the life course). Individuals' wellbeing also tends to be strongly influenced by physical and cognitive wellbeing; nutrition; social and support networks (intergenerational, neighbourhood) and education (Kirkwood & Cooper, 2014).

Wellbeing can be both intrapersonal (e.g. social, morale, identity…) and interpersonal (social participation, social networks, family and social support). Therefore, measuring such multidimensional terms as wellbeing is often challenging.

Table 03 compares the scales used to assess individuals' wellbeing, which have been published from 1975 to the present.

It can be seen from the data that all scales have good reliable coefficients. Among these scales, the SF36v2 was chosen to this study as it met the purpose of this study by assessing health-related wellbeing and it has been applied previously to the older adult population *(e.g.* Lee, Chan & Mok, 2010). In addition, permission was given by the Optum enterprise to use the scale in both language versions (Portuguese and English).

Table 03. Selection and comparison of scales used to measure individuals' wellbeing

Scales	Purpose	Reliability	Applied to older population	Available in Portuguese
WHO-5	Screen for subjective wellbeing	0.93	✓	✓
Philadelphia Geriatric Centre Morale Scale	Assess the psychological state of older adults	0.81-0.85	✓	✓
The Warwick Edingburg Mental Wellbeing	Assess the participants' mental wellbeing	0.81-0.91	NF	NF
The Ryff scale of psychological wellbeing	Assess the different domains of psychological wellbeing (self-acceptance, autonomy, environmental mastery...)	0.86-0.91	✓	✓
The Psychological General Wellbeing (PGWB) Index	Assess self-representations of interpersonal affective or emotional states that affect subjective wellbeing.	0.94	✓	✓
BBC Wellbeing scales	Assess a range of factors that influence personal wellbeing.	0.935	✓	✓
SF36v2	Assess the perception on health-related wellbeing and comprises of two health component summary measures (physical and mental).	0.88-0.97	✓	✓
QOL-Enjoyment	Assess the participants' degree of enjoyment and satisfaction.	0.74-0.92	NF	✓

Note: Scales with reliability coefficients below the cutoff value for social science research (a = 0.70) or a not found value were deleted (Nunnaly & Bernstein, 1994). | NF = Not found

1.2.2 The concept of quality of life

Quality of Life has become a key indicator in statistics, economics and politics, aiming at assessing and comparing different countries and lifestyle patterns. Indeed, the OECD Better Life Index (www.oecdbetterlifeindex.org) is an example of an interactive tool with the purpose of assessing the quality of life of world citizens. In this example, however, quality of life is seen as a standard based on the following domains: housing, income, jobs, community, education, environment, civic engagement, health, life satisfaction, safety and work-life balance.

The concept of Quality of Life has been challenged by studies over the years. The first appearance of the term is suggested to emerge during the 1900s with Bernard Shaw (as cited in Fayers & Machin, 2013):

> *"Life at its noblest leaves more happiness mere happiness far behind; and indeed cannot endure it… Happiness is not the object of life; life has no object; it is an end in itself, and courage consists in the readiness to sacrifice happiness for a positive quality of life."*

In Shaw's statement, difference between happiness (ephemeral state) and quality of life (long-term intervention) is clear. The 1960s also brought to the surface concerns with citizens and their quality of life and since then, new questions for setting quality of life as a parameter to assess the individuals' health with the advancements in technology and social planning (Power, 2003, as cited in Efklides & Moraitou, 2013).

The subordination of life to the labour and economic production has also begun to be strongly criticized, leading to concerns with health, personal freedom, and welfare, among other factors. As Galbraith (1967, p.9) notes: "What counts in no the quantity of our goods but the quality of life."

This concern is also expressed by Robert Kennedy, who gave the following speech in 1968 (as cited in Costanza, Hart, Talbert, & Posner, 2009, p.7):

> *"The gross national product does not allow for the health of our children, the quality of their education or the joy of their play. It does not include the beauty of our poetry or the strength of our marriages, the intelligence of out public debate or the integrity of our public officials. It measures neither our wit nor our courage, neither our wisdom nor our learning, neither our compassion nor our devotion to our country. It measures everything, in short, except that which makes life worthwhile."*

These concerns over time have revealed a need to be explicit about exactly what is meant by "Quality of Life." Although there is not yet a consensus about its definition, several attempts (e.g. Cella, 1994; Felce & Perry, 1995) have been made to clarify the concept. The following are some examples of its definition.

According to the World Health Organization (1994, as cited in Skevington, Lotfy, & O'Conell, 2004, p.299), Quality of Life can be defined as "an individual's perception of their position in life in the context of the culture and value systems in which they live, and in relation to their goals, expectations, standards and concerns."

In *Quality of Life and Older People*, Bond and Corner (2004) list eight specific domains that are relevant for assessing the equality of older adults. These are: (a) Subjective satisfaction; (b) Physical environment; (c) Social environment; (d) Socio-economics; (e) Cultural factors; (f) Health status; (g) Personality; and (h) Personal autonomy.

Bowling (2005, p.220) also enumerates the following principles to enhance quality of life in later age: (a) have an optimistic outlook and psychological wellbeing; (b) have a good health and physical functioning; (c) strengthen social networks and neighbour ties; (d) embrace on social activities; (e) have an adequate income; and (f) maintain a sense of independence and control over life.

Collectively, these definitions outline the importance of individuals and their perception of positive experiences that can change over time. This fact brings additional challenges to assess both subjective experiences and external factors that are associated with quality of life.

Table 04 compares the scales used to measure individuals' quality of life that were published from 1991 to the present. The WHOQOL-100 scale has been disregarded as it wouldn't be feasible for this research to administer a scale with such a higher number of items as 100 to a small number of participants and following a two-treatment counterbalanced design.

The WHOQOL-BREF scale seems to meet the purpose of this study in terms of assessing the predictors of the individuals' perception of their quality of life. It has been developed by the WHOQOL group (WHOQOL Group, 1998; Vaz-Serra, 2006) and encompasses the four dimensions proposed by the World Health Organizations' definition of quality of life (WHOQOL group, 1998): (1) the physical condition; (2) the perceived emotional and cognitive condition; (3) the perception on the number and

quality of social relationships; and (4) the perception of own context and environment. This 26-item scale rated on 5-point *likert* scale (low score 1 to the high score of 5) is also available and validated in English and Portuguese, being also used in geriatric patients, dementia and Parkinson's disease.

Table 04. Selection and comparison of scales used to measure individuals' quality of life

Scales	Purpose	Reliability	Applied to older population	Available in Portuguese
WHOQOL-BREF	Assess the psychological state of older adults	0.81-0.85	✓	✓
ProQOL	Assess the participants' professional quality of life (e.g. risk of burnout, trauma…)	0.81-0.85	✓	✓

Note: Scales with reliability coefficients below the cutoff value for social science research (a = 0.70) or a not found value were deleted (Nunnaly & Bernstein, 1994). | NF = Not found

Considering all of this evidence, it seems that The SF36v2 health-related wellbeing (Maruish, 2011) and the WHOQOL-BREF (WHOQOL Group, 1998) are the most suitable instruments for data collection to meet the purpose of this research.

1.3 The role of intergenerational networks in an ageing society

During the past few years, intergenerational communication has been threatened by the digital divide (Aarsand, 2007) and, consequently, by disparities in authority of (grand) child - (grand) parents' relationships (Mesch, 2006). The family structure is also changing and there is often a gap between younger and older generations, regarding their use of technological devices, the language used and, consequently, their level of connectedness and intimacy (Harwood, 2007).

Recent studies (*e.g.* Harwood, 2007; Stelle et al., 2010) in intergenerational relationships have heightened the need to encourage communication, communal activities, solidarity and social connectedness between different generations (mainly between older adults and children).

In the Guide to the National Implementation of the Madrid International Plan of Action on Ageing (UN, 2008, p.6), the United Nations notes that a 'society for all ages' is more and more in demand. In fact, intergenerational relationships tend to play a critical role in the individuals' wellbeing and quality of life (Walker, 2002). Along with the need for

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strengthening intergenerational ties within a society, these relationships are characterized by both solidarity and conflicts (Harwood, 2007).

According to Bengston and Roberts (1991), intergenerational solidarity can be affected by the following factors: (a) structure and proximity (relative to the geographical proximity); (b) association (relative to the frequency and interaction patterns); (c) function (relative to the financial or instrumental support); (d) consensus (relative to shared values, attitudes and beliefs); and (e) normality (strength of the obligation felt towards each individual). In contrast, the intergenerational conflicts are often due to gaps in the fulfilment of these dimensions, fuelled by stereotypes and media portrayals.

The interest to maintain these interactions among different generations is both a biological and cultural transmission phenomenon (Trommsdorff, 2009). In other words, the need of security and attachment in infancy from family caregivers can strongly influence the individuals' cognitive, emotional and social development (Ainsworth, Blehar, Waters, & Wall, 1978, as cited in Trommsdorff, 2009; Bowlby, 1982). In addition, a proximate context and the shareability of the same historical and social background between two generations facilitate the process of transmitting their own values, knowledge and practices (Harwood, 2007; Kornhaber & Woodward, 1981).

Drawn on the studies of Bengston and Roberts (1991) and Harwood (2007), a model of intergenerational connectivity is proposed in this thesis (Figure 05). As shown in the model (Figure 05), three possible scenarios are suggested to occur: (a) Strong connectivity (Multiple generations together); (b) Triadic encounters (The generation messenger); and (c) Weak connectivity (The generation crisis).

In the first scenario of Figure 05 (Strong connectivity – Multiple generations together), individuals are active agents in the interaction process and develop trust relationships, secure attachment bonds and directly transmit own values, knowledge and practices. In Triadic encounters (The generation messenger), the values, knowledge and practices are mediated by one generation, who acts as a messenger. In this scenario, alliances and coalitions between two generations are likely to occur. Finally, in Weak connectivity (The generation crisis), relationships tend to be casual and there are often deficiencies in the transmission of values, knowledge and daily practices.
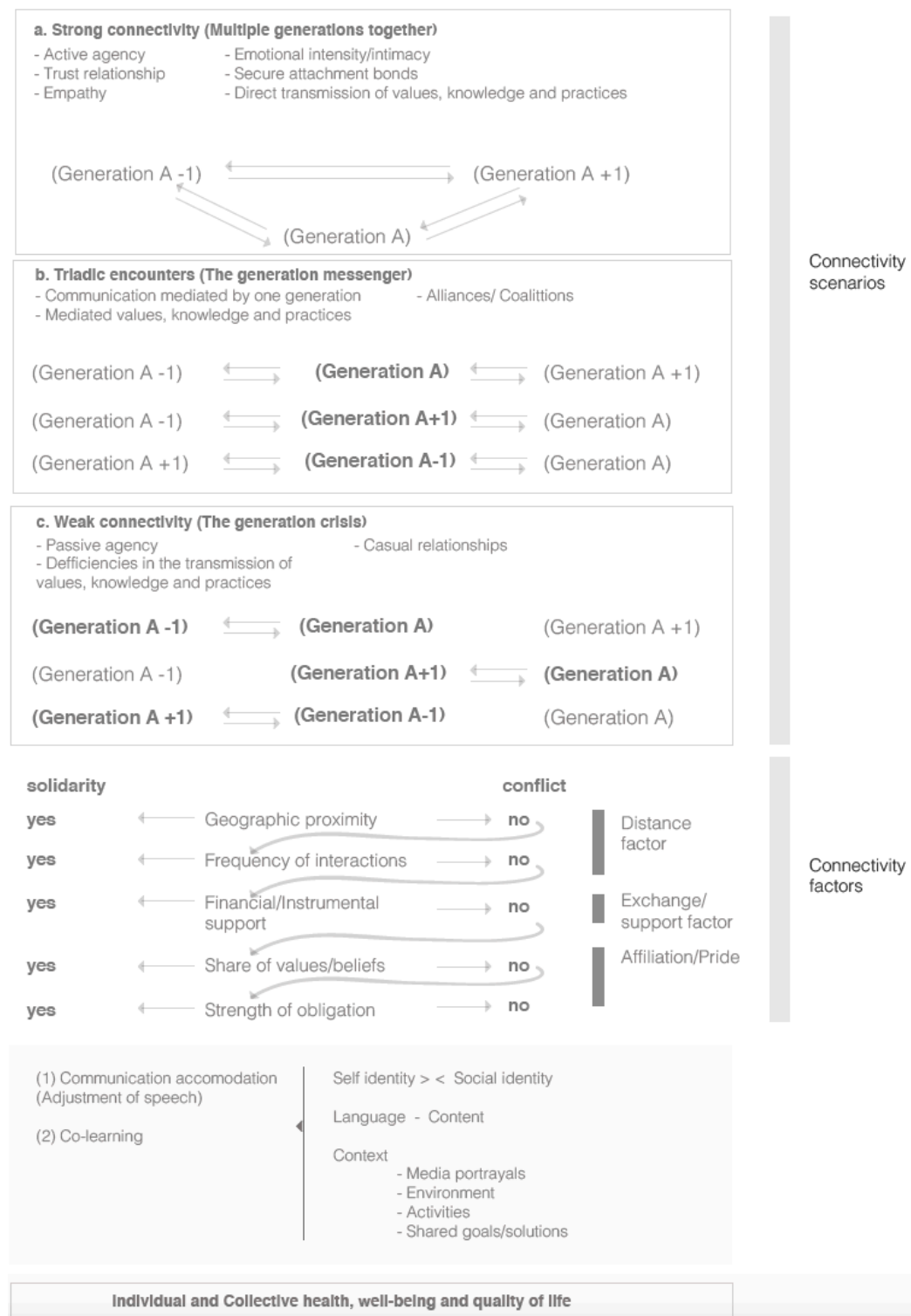
Figure 05. Model of intergenerational connection

(based on the studies of Bengston and Roberts (1991) and Harwood (2007))

In terms of the factors that can affect intergenerational connectivity, they are: geographic proximity, frequency of interactions, financial/instrumental support, share of values/beliefs and strength of obligation. These factors are grouped into the following categories proposed by Harwood (2007): (a) distance factor; (b) exchange/support factor; and (c) affiliation/pride.

Overall, these connectivity scenarios and factors are determined by the individuals' self-identity, language used and own context (influenced by media portrayals, environment, activities and shared goals/solutions) (Kalisch, Coughlin, Ballard, & Lamson, 2013; Kalliopuska, 1994; Schuller, 2010). As a result, communication accommodation (the adjustment of speech) and/or cultural transmission and co-learning may occur.

1.4 Ageing in the Information and Communication Society

The emergence of Information and Communication Technologies (ICT) dates back to the 70s (Castells & Cardoso, 2006) and since then, we have been shaping technology and thereafter technology has been shaping society (McLuhan, 1994). Indeed, mobile networks tend, increasingly, to change the way people exercise their minds (Johnson, 2006) and how they communicate.

Although these networks are often characterized by flexibility, adaptability, inclusion and global transformation (Castells, 2001), a social digital divide is likely to persist. For example, a 'new technological divide' (Castells, 2001, p. 297) can result from such factors and unequal access to digital platforms; insufficient ICT skills; a geographic or a demographic digital divide.

The phenomena of ageing in the Information and Communication Society and the use of digital platforms for active ageing have been major topics of interest within a new scientific subject entitled Gerontechnology (Charness et al., 2001; Fisk, 2001).

According to Bouma, Fozard, Bouwhuis and Taipale (2007), the field of Gerontechnology has the purpose of meeting the challenges of a digital but ageing society. In fact, the authors (Bouma et al., 2007) propose a matrix in which the following domains are represented: Gerontology [Physiology – Nutrition; Psychology – Social psychology;

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Sociology – Demography; Medicine – Rehabilitation] and Technology [Chemistry – Biochemistery; Architecture Building, Mechatronics, Robotics, Ergonomics – Design; Business – Management] that can be intertwined. However, one major drawback of this approach is that Gerontechnology is considered cross-disciplinary, instead of transdisciplinary. A much more holistic approach would illustrate the unity and coherence of the knowledge obtained.

Figure 06 illustrates the convergence of different domains that Gerontechnology can be applied. In this study, the term is used to refer to the science that studies the convergence of different techniques and production of goods or techniques that can act upon the ageing process (i.e. sensation, cognitive processes or operative skills). Specifically, the work of Gerontechnology can fall under three main domains (Figure 06): (a) Anti-ageing technologies that aim to delay or optimize the ageing process; (b) Assistive/Adaptative ageing technologies that aim to assist the older adults to perform activities in their daily routines; and (c) Enhanced/Ameliorated ageing technologies that aim to improve skills and encourage active ageing. Nonetheless, these domains have been challenged by ethics, technology phobia, technology cost, accessibility and user-centred design; security; privacy; and universal design.

In general, 'Games for active ageing' can be classified as belonging to the category of enhanced/ameliorated ageing technologies. Hence, this thesis focuses on the challenges related to the creation of literate and inclusive environments; the problem of technology determinism; and the problem of ageism, techno-ageism and game-ageism.[4]

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[4] The concept of game-ageism is introduced by the researcher based on the concepts of ageism and techno-ageism applied to the context of games

Geron + techn + ology

ageing + technique+ science

science that studies the convergence of different techniques and /or production of goods that can act upon the ageing process (i.e. sensation, cognitive process or operative skills)

Domains

Anti-ageing technologies
Technologies that aim to delay or optimize the ageing process

Examples:
- Regenerative medicine (implants, replace human organs, molecular repair)

Assistive/Adaptative ageing technologies
Technologies that aim to assist the older adults to perform activities in their daily living

Examples:
- Age-smart buildings, home, cities, workplace, transportation;
- Companion robots;
- Rehabilitation;
- ICT-based solutions for social support and caregiving;

Enhanced/Ameliorated ageing technologies
Technologies that aim to improve the older adults skills and encourage an active ageing

Examples:
- Cognitive and physical training technologies;
- Games;
- Electronic Health Records;
- E-health;
- Occupational therapy;
- Technology aids (e.g. glasses, hearing aids);

Main challenges:
Ethics;
Technology phobia & Technology cost;
Accessibility & User-centred design;
Security & Privacy;
Universal design;
Literate and inclusive environments;
Technology determinism;
The challenges of ageism, techno-ageism and game-ageism

Figure 06. Domains of Gerontechnology

1.4.1 Towards informational literacy and digital inclusion

Informational literacy has a pivotal role in developing IT-based solutions (Carbonara, 2005) for improving the individuals' skills (Enhanced/Ameliorated ageing technologies). In fact, literacy and numeracy skills are often the basis of the individuals' informed choices in daily life. Hence, a society in which signs and meanings are produced and circulated, game-based learning can function as 'neo-literate' environments and encourage healthier behaviours and lifestyles by facilitating the process of attributing meaning to information (UNESCO, 2011).

The concept of literacy has evolved over time and there is not yet an accepted definition. Although the term has initially referred to the basic reading and writing competences of an individual, literacy is currently described as the individual's ability to search, interpret and manipulate information (Benavente, Rosa, Costa & Ávida, 1996; Olson & Torrance, 2009; Webber & Johnston, 2000). Similarly, UNESCO (2005, p.21) proposes the following definition:

> *"Literacy is the ability to identify, understand, interpret, create, communicate and compute using printed and written materials associated with varying contexts. Literacy involves a continuum of learning in enabling individuals to achieve his or her goals, develop his or her potentials, and participate fully in the community and wider society."*

In this definition, literacy is presented as a set of competences needed to actively participate in daily life. Hence, whereas alphabetism refers to the individuals' capacity to read and write, literacy is associated with a more complex cognitive process relative to filtering, interpretation and transferability of information to other contexts (Webber & Johnston, 2000).

Although many literacy frameworks have been proposed (e.g. ACRL Literacy Competence Standards, SCONUL – Seven Pillars of Information Literacy, ANZIL – Australian and New Zealand Information Literacy) (Bruce, 2004), they do not clearly show the differences between alphabetism and literacy. Figure 07 illustrates the process of coding and decoding the information presented.

As can be shown in Figure 07, auditory, visual, olfactory and tactile sensations are the basis for making a discourse (texts) and (de) coding the information through language. In fact, these texts can differ in terms of the structure (i.e. expository, procedural, transactional or persuasive) (Thwaites, David & Mules, 2002), type (i.e. physical, digital). Hence, a question that can be posed is whether the multiliteracy concept really exists given the fact that such commonly used notions as 'visual literacy', 'media literacy', 'game literacy', 'digital literacy' vary solely in terms of the text type, structure and format.
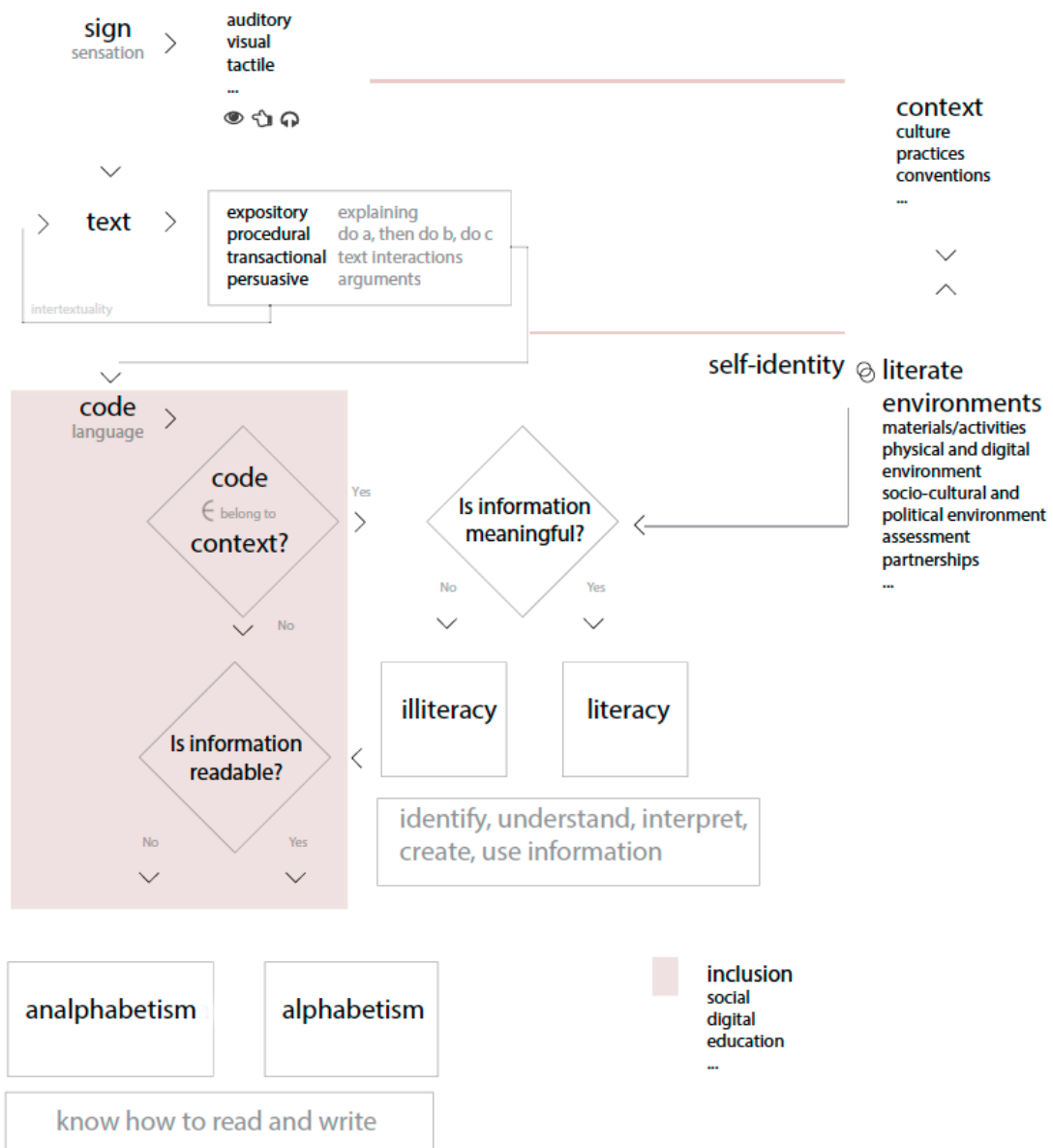
Figure 07. The process of coding/decoding information

After sensation, the text is coded and decoded. If the code used belongs to the context of an individual, two conditions may occur. On the one hand, a scenario of literacy occurs when the individual interprets the information presented. On the other hand, the individual cannot interpret the information but be able to read the text and, in this case, there is a scenario of alphabetism but at the same time of illiteracy.

The advent of the Information and Communication Society have brought the challenge of creating inclusive neo-literate/e-literate environments (i.e. environments that encourage basic reading and writing the texts in new formats – know how to access a menu, understand the conventions used) that expand the competences of an individual to form new ideas or foster critical thinking skills in media ecology (Imel, 1995; UNESCO, 2005).

In the specific case of this thesis, a game-based tool is studied in terms of its role as a neo-literate environment (source of information and communication) to provide a stimulus for active lifestyles. Therefore, the following characteristics of literate environments proposed in the UNESCO report (2011, p.10) are fundamental to define the requirements for developing a game-based learning tool:

- Transfer the literacy skills to daily life activities and tasks;

- Invite the participation of individuals and the use of their literacy skills to interact with the environment (e.g. through delivered narratives, challenges, challenge-based learning, information on demand);

- Give a sense of control over the literacy skills acquired (in terms of the content, time and mode of using);

- Reinforce intrinsic rewards;

- Provide opportunities to participate in the community.

In addition, the elements of the literate environments to be taken into account are (UNESCO, 2011, p.10): (a) literacy materials and activities; (b) physical (and digital) environments; (c) socio-cultural environments; (d) assessment; and (e) partnerships.

To sum up, inclusive and literate environments are becoming central issues for bridging the gaps between generations and facing the challenges presented by an increasingly ageing society.

1.4.2 The problem of technological determinism

The technological determinism is one of the main problems of the Information and Communication Society (Smith & Marx, 1994). Although this challenge dates back to the 18th century with the Industrial Revolution and the ideas of progress and modernism, the belief that technology would be the driving force of society, economics and the environment is still prevalent in the Information Age (Smith & Marx, 1994).

It is believed that one of the first references to the term 'determinism' is in the Leibniz Principle of Sufficient Reason with the notions of predictability and fate (Earman, 1986). Then, this concept has been borrowed from philosophy to refer to the influence of events or actions in an agent or other events.

There are different types of determinism beyond technological determinism. For example:

- Economic determinism occurs when the way goods and services are produced, distributed or traded to exert influence in the society. Economy is seen as the driving force;

- Environmental determinism occurs when the environment exerts influence in society. The environment is seen as the driving force of society;

- Social determinism occurs when society exerts influence in the individual. Society is seen as the driving force of the individual.

In my perspective, the main problem with any type of determinism is the attribution of positive or negative effect to an isolated factor or cause, overlooking mediator variables that can equally exert some influence in the observable effect.

Regarding the problem of technology determinism, Postman (2011, p. 11) points out:

> *"Technological change is neither additive nor subtractive. It is ecological. I mean 'ecological' in the same sense as the word is used by environmental scientists. One significant change generates total change."*

Thus, this research will not address specifically the question of whether game-based learning lead to changes in individuals' habits. Instead, it aims to understand the way that the game-based artefact can be effective to simulate an experience that can motivate and trigger appraisals to change and, thus, affect active ageing.

1.4.3 The problem of ageism, techno-ageism and game-ageism

Age stereotyping is another of the major challenges that can affect the acceptance of technologies in later age and lead to technophobia (Foskey, 2001; Harwood, 2007). Hence, in this section the concepts of ageism, techno-ageism and game-ageism are discussed and an opposite movement is suggested to overcome the stereotypes applied to the game context (age-gameism).

In the Guide to the National Implementation of the Madrid International Plan of Action on Ageing (United Nations, 2008, p. 6), the United Nations note that a 'society for all ages' is more and more in demand. In fact, intergenerational relationships tend to play a critical role in the individuals' wellbeing and quality of life (Walker, 2002). Along with this need to strengthen intergenerational ties within a society, these relationships are characterized by both solidarity (affinity within family relationships) and conflicts (Harwood, 2007).

A. Ageism

Ageism may be broadly defined as an age-related stereotype (United Nations, 2002b) against people because of their age (Australian Right Commission, 2010; Butler, 2005b). This type of stereotyping is mostly applied to older adults and the term ageism often refers to "one means by which the human rights of older persons are denied or violated." (UN, 2002b).

A number of studies (Cuddy, Norton, & Fiske, 2005; Martens, Greenberg, Schimel, & Landau, 2004) have attempted to account for the reason why this stereotype occurred in society as each generation age from the moment they start to live. Martens, Greenberg,

Schimel and Landau (2004) claim that the stereotype may be attributable to the fear of mortality and thus, being in contact with older adults reminds of this human condition and the limitation of time. As a result, the younger generation tends to have contradictory approaches relative to the older adults (Cuddy et al., 2005; Hummert, 1994).

If on the one hand, younger generations have seen older adults as incompetents (low status), on the other hand, they have seen them as affable (passive). This reality often leads to patronizing speech towards older adults (Hummert, 1994). Hence, understanding ageism is extremely important in order to understand its impact on social networks, intergenerational friendships and attitudes towards the ageing process.

Age identity and stereotyping tend to strongly influence communication and social relationships. Indeed, Tajfel and Turner (1979) state that the popularity or discrimination of a group depends heavily on the sense of belonging felt by their members. Furthermore, the individual's identity can be affected by: (a) social mobility (moving from one social group to another –e.g. acting as youngsters); (b) social change (changes in the relationships – e.g. emphasizing the positive aspects of ageing); (c) social creativity (individuals tend to concentrate on positive distinctiveness – e.g. the Red Hat Society); and (d) social competition (competition between groups – e.g. competing with younger generations).

Overall, these different manners of dealing with "older age" identity often reinforce the perceived boundaries between different age groups within a stratified society; and create a distancing effect so that older adults feel a lessened sense of self.

Meanwhile, it is worth noting slight differences between the concepts of stereotyping, prejudice and discrimination. Stereotypes are cognitive schemas whereas prejudices are affective and discrimination is behavioural (Harwood, 2007). In this thesis, only one type of stereotyping is covered – ageism, which can be applied in diverse contexts (e.g. both in the use of technology and digital games).

B. Techno-ageism

One of the most significant current concerns of the Preparatory Committee for the Second World Assembly on Ageing (United Nations, 2002b) and the International Strategy for Action on Ageing 2002 (Sidorenko & Walker, 2004) is the abuse and ageism towards

older adults. These recent advances in the study of the older adult's discrimination have led to the definition of their rights in different forms of abuse: (a) physical; (b) emotional; (c) financial; and (d) neglect.

Although advances in the human's rights to the freedom of opinion and the use of media (Art. 19) have been made (United Nations, 1948), there is still insufficient data for such network vulnerabilities that can occur in the Information and Communication Society.

Pires (2011) was apparently the first author to use the term techno-ageism. For Pires (2011), techno-ageism refers to a set of stereotypes and prejudices regarding the older adults' capabilities to use Information and Communication Technologies. Furthermore, this concept is also used to describe the digital divide between younger and older generations and the core attitudes about the older adults towards the Internet.

Techno-ageism is often associated with the incapability to get acquainted with new contexts and to learn (*e.g.* The proverb 'You can't teach an old dog a new trick'). Another form of techno-ageism refers to the design of digital artefacts that are neither accessible nor suitable for the older adults. It is worth to remember that the Web "is designed to work for all people, whatever their hardware, software, language, location, or physical or mental ability" (W3C, 2013).

C. Game-ageism

Having defined what is meant by Ageism and Techno-Ageism, the term Game-Ageism is now proposed in this thesis to refer to:

- The belief that all members of an age group possess certain game characteristics (e.g. be a social gamer, have low difficulty tolerance, not devote too much time to games), skills (e.g. low problem-solving capacity, not be familiar with the game interface conventions) or attitudes (e.g. be introverted, addicted or gambler; prioritize socialisation over competition) that distinguishes them as inferior to other gamers;

The term also embodies the following meaning:

- Stereotype, prejudice or discrimination against gamers, based on their age and on the assumption that being a youngster is the gamers' standard.

Game-Ageism is a blend of the word "Game" and "Ageism." Like techno-ageism (technologies + ageism), the word game has been added as an affix to provide the context in which ageism can occur. The game concept also embodies various definitions, intertwining the concept of play.

According to Huizinga (2015), play is a free and not serious activity, virtually situated outside of everyday life. In the digital game context, Salen and Zimmerman (2003, p. 80) describe games as "a system in which players engage in an artificial conflict, defined by rules, that result in quantifiable outcome." Thus, for the purpose of this research, we will use the word 'game' with the meaning of a voluntary activity defined by a set of rules and outcome-oriented goals. The concept of 'game' is further discussed later in Chapter 3.

Game-ageism can also affect intergroup communication, forming exclusive 'digital tribes' or 'virtual clans' (Wheeler, 2009) and using age criteria. A recent study by Costa (2013) has reported that individuals in favour of playing in later age tend to base their perspective on reasons for playing (*e.g.* "it helps to keep their mind active") whereas those who are against are likely to support on game experiences (*e.g.* "I just can't see my grandma playing with me"). On the other hand, an inverse phenomenon can also occur – The Age-gameism.

The term Age-gameism in this thesis will refer to:

- Gaining pleasure from playing games and thus, overcoming age-related psychological and social constraints;

This term also encompasses the following meanings:

- Action of playing games vigorously at a certain age, aimed at bringing a social change;
- The willingness to play games and develop gamer skills, regardless of age;

- Age-related benefits brought through the ritual of playing games;

- Being proud to maintain a 'gamer soul' (be committed to game-playing, regardless of age) throughout the ageing process;

- The belief that games are meant for all ages.

In this particular case, gameism (game+ism) refers to the activity, a state/quality and ideological movement of playing games on a certain age. The word 'age' moved to the beginning of the sentence (expressing the context) instead of the word 'game.' It functions as the opposite of game-ageism.

In recent years, grandchildren have been disseminating videos on Youtube of grandparents playing games, as if it was the "coolest grandma or grandpa" contest. The trend shows a prime example of a social movement for the use of games and digital games regardless if the players' age. In addition, many online communities for older gamers (*e.g.* The older gamers, 2old2play…) have been set up. Overall, these initiatives help to reduce the sense of game-ageism and some of them even spread the phenomenon of age-gameism.

Together, the studies presented so far outline a critical role and main challenges of the use of Information and Communication Technologies in an Ageing Society. The following section presents the creation of meaningful learning environments for active ageing by discussing the process of learning and the use of technologies for behavioural change and active ageing.

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2 Meaningful learning environments for active ageing[5]

«Tell me and I'll forget, show me and I
may remember, involve me and I'll understand. »

– Chinese proverb (n.d., as cited in Marín, 2014, p. 2)

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[5] Part of the content of this Chapter has been published in the following papers:

Costa LV, Veloso AI. (2017). Demystifying Ageing Bias Through Learning. In: Beck D, Allison C, Morgado L, Pirker J, Khosmood F, Richter J, et al. (Eds.), *Immersive Learning Research Network: Third International Conference,* iLRN 2017, Coimbra, Portugal, June 26-29, 2017, Cham: Springer International Publishing; 2017. p. 201–13. Doi: http://dx.doi.org/10.1007/978-3-319-60633-0_17

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2 Meaningful learning environments for active ageing

The main issues addressed in this Chapter are: Age-related changes in cognition, Learning experiences in later age, Learning theories and E-learning in later adulthood.

One of the primary concerns of humankind has been the learning process. For example, Egypt's civilization worshiped the God of learning, memory and wisdom, named Thoth, whereas Greeks had their own Goddess of memory, Mnemosyne (Bergamaschi, 2002). Learning has been equally a topic of interest to such philosophers as Aristotle, Plato (Powell, Honey, & Symbaluk, 2016), Confucius (Tan, 2014), Kant, Jean-Jacques Rousseau or Michel de Montaigne (Phillips, 2014; Sharma, 2002). Herein, learning has long been subject of a wide range of fields (*e.g.* education, didatics, andragogy, geragogy...), within the scientific community.

According to Locke, the mind was similar to a blank paper and only experiences would fill it (Gleitman, Fridlund, & Reisberg, 2003). However, the author fails to acknowledge the existence of innate behaviours (e.g. babies' tighten finger or crawl). Consequently, the research experiments of Konrad Lorenz (Drickamer, 2012) with learning in geese came along and have provided additional evidence with respect to these innate behaviours.

Nowadays, the process of learning is known to be strongly influenced and shaped by both experiences and environments. Indeed, Merril (2002, pp. 45–51) suggests that set of

principles of instructions can be followed for creating affective and meaningful learning environments. These are:

- Engage learners in solving real-world problems;

- Link new learning experiences to learner's prior knowledge and competences;

- Use demonstrations and examples to improve learning;

- Provide immediate feedback on learning activities;

- Relate the learning environment to everyday life experiences.

In addition, the immediate feedback is often crucial to design these learning experiences. Drawing on these studies of 'operational learning' described by Mason (2017) and 'flow' introduced by Csikszentmihalyi (1990), figure 08 shows the process of learning based on a stimulus and actions that are dependent on positive or negative outcomes.

As shown in Figure 08, the individual perceive a stimulus (e.g. auditory, visual, tactile) and sets of brain chemicals named Neurotransmitters send signals throughout the brain and body. One of these neurotransmitters – Dopamine - has a crucial role in triggering motivations and rewarding actions. Nonetheless, the release of dopamine is time-limited and its intensity depends on the difference between the time of feedback and the time of the action performed (time of feedback minus time of action or immediacy of feedback) (Mason, 2017).

Hence, one may suppose that when the intensity of dopamine is high and the time of feedback is short, actions are likely to be immediate and perceived as one main action. In this scenario, individuals tend to make decisions based on emotions. In contrast, if the time of feedback is high and the intensity of dopamine is low, actions are fragmented and likely to be performed step by step. Thus, the individual tends to make rational decisions.

When individuals receive positive stimuli, they will likely want to repeat the same stimulus and/or actions. The action performed is dependent on the type of outcome received. After repeating the same action and receiving positive outcomes successively,

individuals will no longer be attentive to the type of outcome and, thus, repeat the same actions over and over again (what is often called 'addiction') (Mason, 2017).
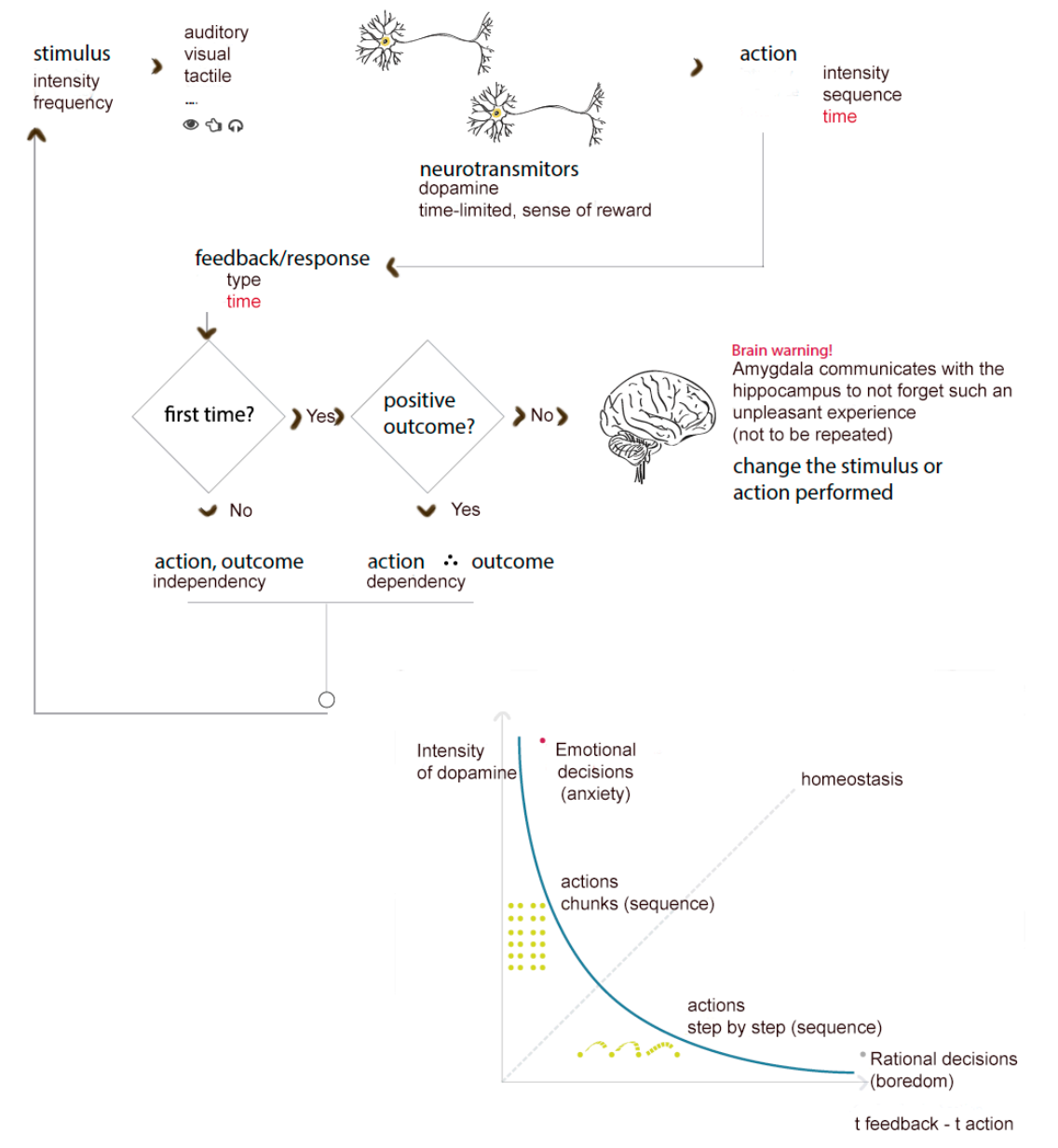
Figure 08. The process of learning based on stimulus and actions (positive or negative outcomes)[6]

One way of discouraging these actions is through the augmentation of the time interval between the outcome and the action performed.

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[6] This scheme is designed by the researcher to illustrate the process of learning based on stimulus and actions, taking into account the studies of Mason (2017) and Csikszentmihalyi (1990)

The process of designing affective learning environments, which bring emotional experiences to the learning process, implies understanding the learner, the learning context and content (Czaja et al., 2013). In the same vein, Wlodkowski and Ginsberg (2017) notes that learning environments should foster positive attitudes towards the learning process and that the meaning of learning activities and ethical issues should be taken into account.

In view of all that has been mentioned so far, this Chapter presents the process of learning in later age, the adult learning principles and the use of learning courses at distance.

2.1 Age-related changes in cognition

The ageing process is often associated with functional and chemical changes in the individual's brain (Goh & Park, 2009). In fact, the human brain is a complex organ that usually functions as a muscle endowed with plasticity. The more the brain is exercised, the more it is likely to be improved. Thus, contrary to the initial assumptions about the progressive and irreversible death of the ageing neurons, current evidences (Goh & Park, 2009) on the ageing brain and neuroplasticity have revealed that whenever the brain is exercised, cognition will decrease at a slower rate and the damaged neurons can be recovered or replaced by other proximate neurons, repairing the nervous system.

In general, age-related changes are essential to design meaningful learning environments. Cognitive decline is mostly associated with the following changes (Czaja et al., 2013; Vaz-Serra, 2006): (a) the increased difficulty in understanding long and/or complex messages and retriece specific terms; (b) greater difficulty in thinking activities involving logical and organized analysis of abstract or unfamiliar materials; (c) difficulty in selecting information; (d) slowdown in the performance of new and fast psychomotor tasks; (e) loss of memory; (f) decrements in selective and divided attention; (g) multitasking; and finally (h) difficulties in inductive reasoning, spatial orientation, numerical or verbal skills. As a result, Table 05 presents some of the implications for designing meaningful learning environments by taking age-related changes into account.

As can be seen from Table 05, there are different learning strategies to overpass age-related cognitive declines. Overall, these implications for designing learning environments

encompass the following variables (Czaja et al., 2013; Findsen & Formosa, 2011): (a) learner; (b) task; (c) training; (d) content; (e) context (social and environment); and (f) cognition.

Table 05. Implications for designing meaningful learning environments based on age-related changes (based on the studies of Costa (2013), Czaja and Sharit (2012); Veloso and Costa (2014)

Age-related changes	Implications for designing learning environments
Information processing is not as fast as in youth	Instructional design for difference learning paces; Lessen cognitive load; Divide information into simple words and pictures.
Loss of working memory (short-term)	Avoid large amounts of information; Relate new knowledge with previous experiences; Incorporate new learning (neuroplasticity – new neurons have stronger connections); Learning experiences can stimulate episodic memory by acting as third 'evocative' places and challenging spatial cognition.
Declines in semantic memory (e.g. historical/cultural facts) and spatial cognition	Connect new learning to real-life events; Familiarize learners with the learning content; Learning objects can activate memories and emotions; Spatial memory and navigation can be activated by learning environments
Declines in procedural memory (know how to perform certain tasks)	Encourage Learn-It-Yourself and Do-It-Yourself philosophies; Stimulate the learners to build and exchange their experiences by bringing moments of their lives into the learning environment.
Decrements in selective and divided attention	Train visual selective attention skills and decision-making (neuroplasticity – new neurons have stronger connections).
Declines in sensory capacities (e.g. auditory, visual, tactile)	Incorporate multimodal feedback; Multimodal interfaces can activate auditory, somatic, visceral, gustatory and visual senses; Follow a set of usability and accessibility guidelines.
Declines in speech, language comprehension or numerical skills	Encourage reading comprehension and spelling through narrative and reading materials;

Figure 09 illustrates the essential variables for designing meaningful learning environments. These variables are:

- The tutor. Tutors are the instructors or lecturers of a learning course. Their prior experiences and skills are important to the learning environment;

- The learner. A meaningful learning environment should meet the learners' prior experiences, health status, motivation and skills;

- Cognition and context are also essential variables to the learning process. Cognition is related to interpretation, actions, emotions and motivations of the learning

entities whereas context is related to communities and social environment;

- Training is relative to the use of competences. Training activities are divided into sequences of instructions, goals and related outcomes;

- The task performed is characterized by: (a) level of complexity; (b) sequence; and (c) related outcomes.

- Regarding the learning content, the subject, the sequence, quantity and quality of the information (whether it comes from a reliable source and it is updated) are important aspects to take into account.
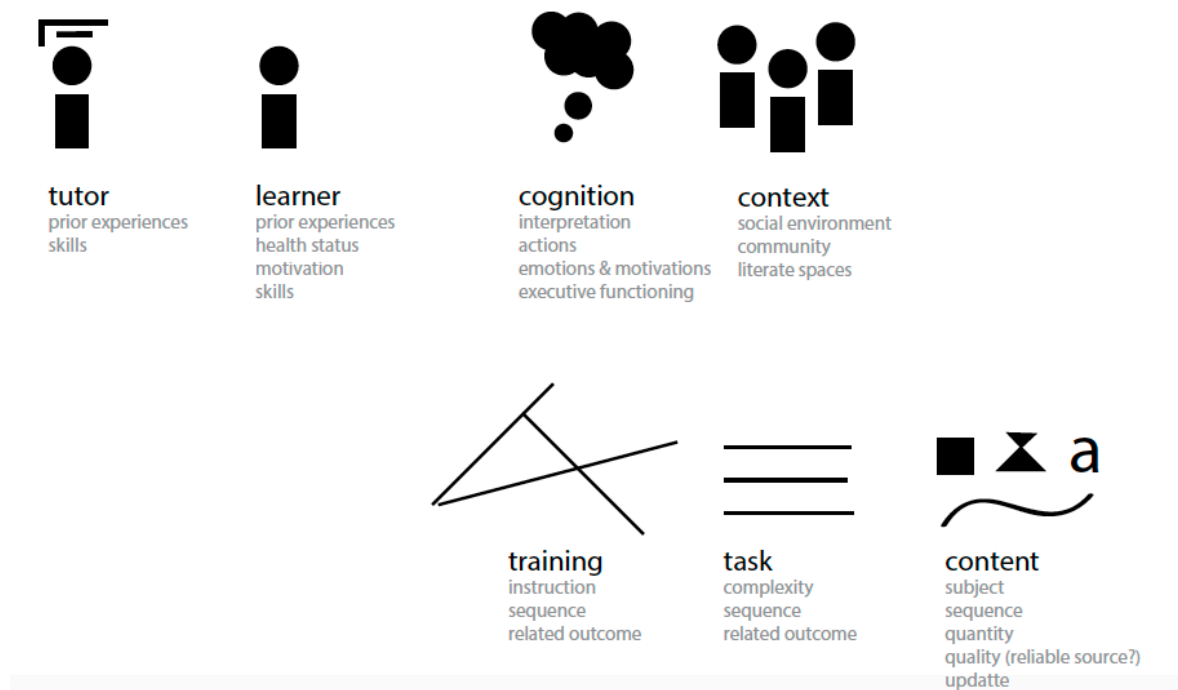
Figure 09. Essential variables to design meaningful learning environments (based on the studies of Czaja and Sharit (2012), Findsen and Formosa(2011)

Intellectual stimulation, sociability and skills enhancement are suggested to be the main reasons for older adults to adhere to a learning programme (American Council on Education, 2008; Manheimer, 2005). By contrast, there are some pre-determined obstacles that can affect older adult learning.

Dakenwald and Merriam (1982, as cited in Findsen & Formosa, 2011) list the following barriers to learning:

- *Situational barriers* are related to personal experiences in a certain period of time;

- *Institutional barriers* that often determine the target group, who will benefit from the learning course;

- *Informational barriers* are related to the divulgation of the learning courses that are available as well as the learning opportunities;

- *Psychological barriers* are related to the learners' attitudes towards learning and their motivations.

Before proceeding to examine distance learning, it is necessary to understand the adult learner and the theories of learning and learning styles.

2.2 Learning experience in later age

Learning tends to play a vital role in human development and progress (Hurd, 1998; Swanson & Holton, 2001; Knowles, Holton & Swanson, 2005). Although extensive research has been carried out on the process of learning in children (Berk & Winsler, 1995; Bloom, 1981; Rogoff, Turkanis & Bartlett, 2001; Tizard & Huges, 2008; Vygotsky, 1978), few studies have addressed adult learning (e.g. Findsen & Formosa, 2011; Kern, 2014; Knowles, Holton & Swanson, 2005).

Compared to learning in children, adult learners have prior experiences and different motivations that should be brought to the learning environment (Findsen & Formosa, 2011; Whihtnall, 2010). Therefore, the elements of a learning experience in later age, level formality and principles of learning are discussed in this section.

It is worthy mentioning, however, that the focus of this thesis is on adult learning and not on adult education. According to Withnall (2010), education differs from learning in a number of important ways. Whereas learning refers to an individual process of obtaining new knowledge, education is associated with a formal context that facilitates learning (Withnall, 2010). Boyd, Apps and other authors (1980, as cited in Knowles, Holton & Swanson, 2005) also highlight that learning is an act or process in which changes in behaviours, skills and attitudes can occur. Hence, learning can be crucial to foster the sense of citizenship and reinforce the values of democracy, equality or justice and contribution to scientific, economic and social development (Biesta, 2011; Lee, 2013).

The first serious discussions and analyses of adult learning have emerged during the 70s with Malcom Knowles. The author (Knowles, Holton & Swanson, 2005, p.2) uses the

concept of Andragogy [greek roots – andr (man), agogos (learning) and logy (study) (Davenport & Davenport, 1985)] to refer to:

> *"Core principles of adult learning that in turn enables those designing and conducting adult learning to build more effective learning processes for adults."*

- Knowles, Holton and Swanson (2005, p.2)

These principles mentioned are the following (Knowles, Holton, & Swanson, 2005, p.3): (i) the learner's need to know; (ii) self-concept of the learner; (iii) prior experiences of the learner; (iv) readiness to learn; (v) orientation to learning; and (vi) motivation to learn.

Similarly, other studies (e.g. Bollnow, 1962, as cited in Kern, 2014; Lemieux & Martinez, 2000; Peterson, 1976) have attempted to define the interdisciplinary field of study of learning in later adulthood. Such concepts as geragogy [gerontagogy [greek roots – geront (old man), pedagogy (paidos – child + ago-lead, logy –sudy of)] (Lemieux & Martinez, 2000) and education gerontology (Peterson, 1976) have been proposed. Nonetheless, these concepts often overlook the fact that learning is an experience to be designed in formal, non-formal or informal contexts (Jarvis, 1985).

Formal learning is characterized by hierarchical, institutionalized and structured systems, normally with rigid norms. Examples of formal learning in later age are the Universities of Third Age, Institutes for learning in retirement or Elderhostels.[7]

In regards to non-formal learning, this occurs in a non-sequential and non-hierarchical manner, which is often fuelled by social groups or networks. Examples of non-formal learning contexts are voluntary organisations, churches, sports and clubs.

Finally, informal learning is often spontaneous, experimental and embedded in daily living activities. Examples of informal learning contexts can be television, games, radio or family background.

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[7] Example of Universities of Third Age: https://www.u3a.org.uk/ (Access date: Nov 2nd, 2017)
Example of Institutes for learning in retirement: http://www1.american.edu/ilr/main.html (Access date: Nov 2nd, 2017)
Example of ElderHostel: https://www.roadscholar.org/about/our-story/ (Access date: Nov 2nd, 2017)

In this thesis, learning is defined as an experience (Figure 10) and as such, the learner, the learner's rights, the learning organizations, and the learning partnerships are important aspects to design meaningful learning experiences in later age.

learning experience (lx) in later age

disciplines

andragogy: andr (man) + agogos (learning) + logy (study of)
geragogy: geront (old man) + agogos (learning) + logy (study of)
gerontagogy: geront (old man) + pedagogy (paidos - child + ago - lead + logy - study of)
education gerontology

rights

lifelong learning and training
>access to education and training programs

"Provision of opportunities for individual development, self-fulfilment and well-being throughout life as well as in late life, through, for example, access to lifelong learning participation in the community while realizing that persons are not an homogeneous group." (Second World Assembly on Ageing, 2002, p.7)

learner

older workers
>update skills
>self-concept
>prior experiences
>direct learning to the job function;
>on-the-job training;
>mentoring opportunities;
>vocational (workplace) context.

learning organization
> share of skills, knowledge, experiences and practices

post-retired
> intrinsic motivations
> self-concept
> direct learning to real-world problems
>opportunities for participating in society
>non-vocational (liberal) context

learning partnerships
> intrinsic motivations
> self-concept
> direct learning to real-world problems
>opportunities for participating in society
>non-vocational (liberal) context

Figure 10. Learning experience (LX) in later age

According to Findsen and Formosa (2011), the context of the learner can be twofold:

a) Vocational (workplace) context. Older workers aim to update their skills and expect that learning outcomes will bring some benefits to their job function in the enterprise. On-the-job training and mentoring opportunities should be encouraged.

b) Non-vocational (liberal) context. Post-retired people have intrinsic motivations and often expect that learning experiences will be directed to real-world problems. Opportunities for participating in society should be encouraged.

Relative to the older adult learner's rights, access to education and training is a priority defined in the Second World Assembly on Ageing (UN, 2002a, p.7):

"Provision of opportunities for individual development, self-fulfilment and wellbeing throughout life as well as in late life through, for example, access to lifelong learning participation in the community while realizing that persons are not an homogeneous group."

- UN, 2002a, p.7

A pioneer in widening older adults' access to learning opportunities was the University of Third Age [UTA] founded in 1972, in Toulouse. According to Vellas (1997, as cited in Findsen & Formosa, 2011), the main purposes of the University were: increasing the learners' sense of wellbeing and quality of life; and encouraging intergenerational relationships. Other important entities in this learning experience are learning organisations and learning partnerships.

The author Senge, who coined the term 'learning organisation' presents it as the product of the interactions and thoughts of its members. As Senge (2014, p.49) states:

"Learning in organisation means the continuous testing of experience, and the transformation of that experience into knowledge – accessible to the whole organization, and relevant to its core purpose."

These organisations are characterised by Senge (2014) by their personal mastery, team learning, system thinking and mental models, which stem from a shared vision of the

organisation. Similarly, learning partnerships can reinforce the share ability of skills, knowledge, experiences and practices.

In regards to the principles of adult learning, the Figure 11 shows the main principles announced by the Madrid International Plan of Action on Ageing (UN, 2008), the Hamburg Declaration on Adult Learning (UNESCO, 1997) and the Andragogical principles presented by Knowles, Holton and Swanson (2005).

principles of adult learning

political declaration and madrid international plan of action on ageing (UN, 2002)	the hamburg declaration on adult learning (UNESCO, 1997)	andragogical principles (Knowles, Holton, & Swanson, 2005, p.160)
(1) ensure lifelong education and training; (2) encourage older adults' participation in society through learning; (3) encourage the use of information and communication technologies in learning and adjust them to age-related difficulties. (4) provide training opportunities for older workers	(1) overcome the challenges of the twenty-first century relative to adult learning and democracy; (2) improve the conditions and quality of learning; (3) ensure the rights to literacy and basic education; (4) ensure equality in education by gender; (5) adapt adult learning to the changing world of work; (6) adapt adult learning to environment, health and population; (7) provide opportunities to participate in culture and use media and new technologies; (8) adopt the philosophy "Adult learning for all" (9) fund adult learning (10) strengthen international cooperation and solidarity	(1) Match the contents of the learning needs (to know a priori 'what', 'why' and 'how'); (2) Meet the learning self-concept (foster autonomy and self-direction); (3) Meet the applicant previous experience (mental model, experiences ...); (4) Direct learning to problems in concrete and related to everyday life; (5) Guide the learning problems and to meet the context of the trainees; (6) Answer the motivations for learning of trainees (intrinsic value and personal reward).

Figure 11. Principles of adult learning based on the Madrid International Plan of Action on Ageing, the Hamburg Declaration on Adult learning and the Andragogical Principles

From the principles shown in Figure 11, it is apparent that providing opportunities to participate in society, meet the context of the learners and adapt abstract concepts to real-life scenarios are the most common recommendations. In addition, these principles corroborate the studies of Tuijnman and Bostrom (2002), Formosa (2002), and Veloso, Ferreira, Soares and Costa (2015).

Tuijnman and Bostrom (2002) have suggested the following ligelong learning principles: flexibility; diversity in content; universality; self-directed learning and learner-centred design; on-the-job and vocational training; social innovation and leisure-oriented model; cooperation; and mobility. The same authors have also proposed the general key-performance indicators in terms of the effectiveness of a lifelong learning programme: (a) the ability to learn; (b) motivation to learn; (c) time to learn; (d) level of formality; (e) learning tools and (f) linkeage between the daily life and the learning content.

As for Findsen and Formosa (2011), they recommended that learning environments should: (a) transform ageist attitudes towards learning and ageing; (b) take into account the context of learner; and (c) provide mechanisms of self-help.

Finally, the authors Veloso, Ferreira, Soares and Costa (2015) provide the following recommendations: (a) the learning instructions should be based on short messages and simplified terms; (b) the learning problems should be subdivided into simple and easy-to-understand tasks; (c) the learning instructions should be adjusted to individual learning pace; (d) the instructor should provide continuous and immediate feedback on the task; (e) demonstrations and supporting materials should be given, preferably on paper, in order to guide learning activities and overcome difficulties with short-term memory; and (e) appropriate tasks to the learners' skills and rhythm of learning should be presented.

Together, the studies mentioned suggest such adult learning recommendations as designing goal-oriented learning programmes; creating collaborative and safe learning environments (taking into account the learners' pace and confidentiality); matching the knowledge transmitted to the learners' life experiences; and motivating the adult learners to produce their own learning artefacts and share them with younger generations. Nonetheless, it should be noted that the learning process is not homogeneous and different learning styles should be considered. Hence, the following section is devoted to the theories of learning.

2.3 Learning theories

A considerable amount of literature has been published on learning theories (*e.g.* Bandura, 1971; Cooper, 1993; Pritchard, 2009; Siemens, 2014; Watson, 1913), however, data seems to be scarce in terms of the convergence between the adult learning principles, learning theories and the theories and principles applied to game-based learning.

Figure 12 shows the relationships that can be established between the learning theories (*i.e.* behaviourism, cognitivism, construtivism and connectivism), theories applied to game-based learning and principles on adult learning (*e.g.* design goal-oriented learning programmes and meet the learners' previous experiences).

Before proceeding to examine each theory, it is necessary to note that the concept of theory implies sets of observations and an attempt to explain a certain phenomenon or problem. Thus, these theories should be interpreted with caution, as observations may change over time.

The key learning theories can be listed as follows: behaviourism, cognitivism, construtivism and connectivism.

A. Behaviourism

Over the twentieth century, behaviourism has been a dominant theory applied to the learning context. In this theory, the process of learning is seen as a result of an environmental stimulus and learners' behaviours are shaped by positive or negative reinforcements (i.e. rewards or punishment). In 'Psychology As the Behaviorist Views It', Watson (1913, p.158) writes:

> *"The behaviorist, in his efforts to get a unitary scheme of animal response, recognizes no dividing line between man and brute. The behavior of man, with all of its refine and complexity, forms only a part of the behaviorist's total scheme of investigation."*

The main weakness with this theory, however, is that man does not differ from an animal and thus, their actions are solely influenced by environmental stimulus and positive and negative outcomes.
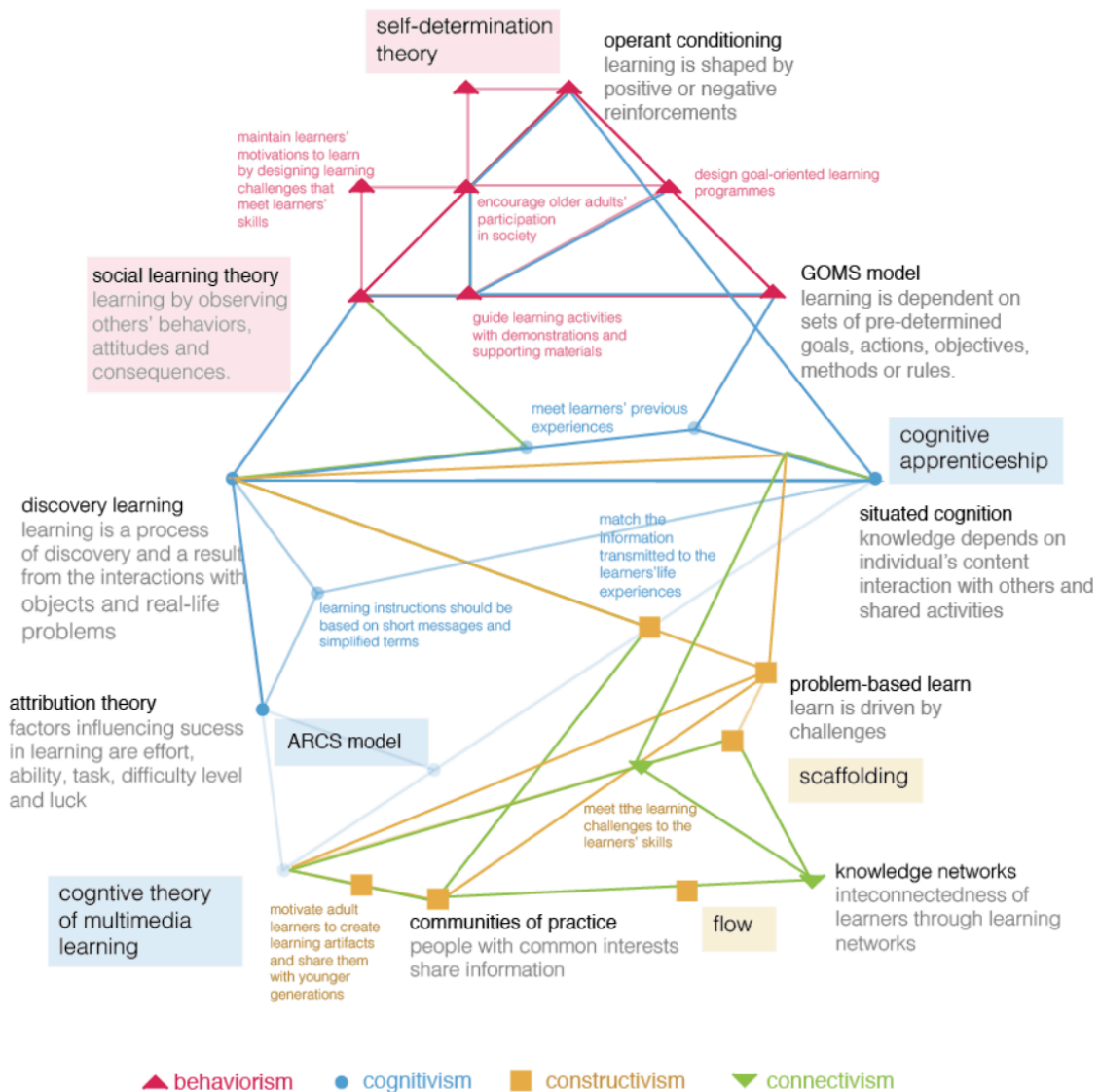
Figure 12. The relationship between learning theories, theories applied to game-based learning and principles of adult learning[8]

For example, Watson's famous quote (1926, p.10, as cited in Hergenhahn & Henley, 2014, p.390) illustrates the importance of the environment in individual's behaviour:

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[8] This scheme is proposed by the researcher in order to illustrate the relationship between learning theories, theories applied to game-based learning and principles of adult learning

"Give me a dozen healthy infants, well-formed, and my own specified world to bring them up in and I'll guarantee to take any one at a random and train him to become any type of specialist I might select – a doctor, lawyer, artist, merchant-chief and, yes, even to beggar man and thief, regardless of his talents, penchants, tendencies, abilities, vocations and race of his ancestors."

Other theories have derived from behaviourism. Operant conditioning, The GOMS (Goals, Operators, Methods, Selection, Rules) model; Social Learning Theory and Self-Determination Theory are some examples (Kuittinen, 2011; Bandura, 1971).

i.   *Operant Conditioning*

The Skinner's Operant Conditioning Theory (1983, as cited in Goldstein, 2014) is centred on positive reinforcements on an individual's actions. In other words, an individual's actions are stimulated by positive reinforcements (e.g. rewards) and inhibited by negative reinforcements (e.g. punishments).

ii.   *Social Learning Theory*

The Bandura's Social Learning Theory transits from behaviourism to cognitivism. Individuals learn through observational learning (by observing others' behaviours, attitudes and imitating) (Shaffer, 2008).

The theory is related to the adult learner's principles: (a) maintain learners' motivations to learn by designing learning challenges that meet the learner's skills; (b) encourage older adults' participation in society (intrinsic motivations); (c) design goal-oriented learning programmes (GOMS model); and (d) guide learning activities with demonstrations and supporting materials.

In terms of the learning theory that can support behaviourism in games, self-determination theory is fundamental to understand how games can motivate and reward learning efforts (Kapp, 2012).

There are different types of motivations. They can be divided into the following types (Deci & Ryan, 2002;Brander, 2008):

- *Amotivation*. Amotivation occurs when individuals are indifferent, not engaged and unwilling to perform certain activity;

- *Extrinsic Motivations*. In this type of motivation, individuals need an external motivator in order to operate. These extrinsic motivations can be differently regulated by: (a) External regulation (when somebody asks/says to do something); (b) Interjected regulation (accept external motivations and be moved by status, social pressure, among others); (c) Identified regulation (the same process of interjection, but at this time, the individuals are not moved by status or social pressure); and (d) Integrated regulation (the goals of the task are aligned with the intrinsic goals)

- *Intrinsic Motivation*s. In this type of motivation, individuals are internally moved (e.g. by passion or fun) to do the activity.

Overall, meaningful learning environments are solely designed when strategies are delineated for increasing the learners' perceived competence (encourage the sense of mastering, success in solving problems and accomplish main goals); autonomy (feel in control over an activity); and relatedness (communicate the purpose of the activity).

B. Cognitivism

Cognitivism has emerged as a response to the limitations of behaviourism. Indeed, gestaltism (Wertheimer & Riezler, 1944) and Chomsky's critique of Skinner's Verbal Behaviour book have led to discussions on Information Processing (Broadben, 1982) and Artificial Intelligence (Newell & Simon, 1972).

For example, commenting on Skinner's study, Chomsky (1959, p. 49) argues:

"[...] One would naturally expect that prediction of the behaviour of a complex organism (or machine) would require, in addition to Information about external stimulation, knowledge of the internal structure of the organism, the ways in which it processes input information and organizes its own behaviour."

In Chomsky's account of the limitations surrounding behaviourism, one can note that in cognitivism, the learner is seen as information processor and learning is based on mental

constructions of daily life events and symbols (Gruber & Mandl, 2000, p. 386).Some examples of theories that have derived from cognitivism are Attribution theory (Weiner, 1985) and Cognitive Theory of Multimedia Learning (Mayer, 2002).

In regards to Attribution theory, Weiner (1985) suggests that the factors that can influence learning success are: effort, ability, task, difficulty level and luck. Motivation and emotions are, therefore, the basis for learning.

In the cognitive theory of multimedia learning, learning implies to know how to filter, select, organise and manipulate information. Indeed, words and pictures can be easier 'processed' than just words. Thus, Technologies of Information and Communication can facilitate the end-users through the process of learning by providing multimodal texts.

As for situated cognition, this theory may be inserted in cognitivism, constructivism, and connectivism. In fact, this theory suggests that knowledge and the learning process depends on the individuals' context, interaction with others and shared activities. This theory is the basis of cognitive apprenticeship that can be applied into games (Kapp, 2012), given the fact that they may encourage joint activities and provide learners with a sense of control and mastery in learning environments (Kapp, 2012; Gee, 2007). This theory is related to the adult learners' principles: (a) learning instructions should be based on short messages and simplified forms; and (b) match the information transmitted to the learners' life experiences.

The ARCS model (attention, relevance, confidence and satisfaction) is also intertwined with the use of cognitivism in games, being important to develop and assess the instructional design (Keller, 1987). According to Kapp (2012, p. 53), games can:

- Hook the attention of learners through 'perceptual arousal', 'inquiry arousal' and variability in game elements and instructional methods;
- Be relevant to the learning experience by presennting goals, meeting the learners' motivations and link the information given to previous learners' experiences;
- Foster the learners' confidence, sense of mastery and control over learning;
- Satisfy the learners through encouragement and immediate feedback on their actions.

C. Constructivism

In construtivism, learners are seen as active constructors of their klnowledge. In fact, learning is driven by problem-based challenges and personal discovery (Cooper, 1993; Schunk, 1996). Moreover, social interactions are fundamental to facilitate the process of constructing knowledge.

These are three different types of construtivism (Schunk, 1996):

- *Exogeneous:* External environment influences knowledge constuction;
- *Endogeneous:* Knowledge derives from previous learning experiences;
- *Dialectical:* Knowledge results from the interactions between agents and the environment (Vygotsky, 1962, as cited in Schunk, 1996).

Some examples of theories that have derived from construtivism are discovery learning (Bruner, 1979) and problem-based learning (Savery & Dufft, 1996). In discovery learning, individuals learn by exploring, manipulating objects and interacting with the learning environment (Moreno, 2004) whereas in problem-based learning, problems and challenges that meet the learners' skills are the basis of self-direct and meaningful learning experiences (Savery & Duffy, 1995).

Constructivism is related to the following adult learners' principles: (a) adapt the learning challenges to the learners' skills; and (b) motivate adult learners to create learning artefacts and share them with younger generations.

As for the learning theory that can support construtivism in games, scaffolding seems to be the most relevant. According to Kapp (2012, p. 53), scaffolding is:

> *"[…] process of controlling the task elements that initially are beyond the learner's capacity, so that the learner can concentrate on and complete elements within his or her immediate capability. Once the task is accomplished, the learner is then led to accomplish another goal that builds upon the previous."*

One example of scaffolding is the game levels, which challenges become progressively difficult as players master the challenges of the previous levels (Kapp, 2012).

Another theory that can be related to constructivism in games is the theory of flow. According to Csikszentmihalyi (1990), the optimal expeerience is characterized by an achievable task/challenge; the ability to concentrate on the task; clear goals; feedback; effortless involvemnet; sense of control over actions; loss of self-consciousness; and transformation of time (Csikszentmihalyi, 1990).

D. Connectivism

Finally, connectivism can be related to other learning theories that were mentioned earlier. In connectivism, knowledge is distributed in a network.

As Siemens (Siemens, 2014, p. 5) states:

> *"Connectivism is the integration of principles explored by chaos, network, and complexity and self-organization theories. Learning is a process that occurs within nebulous environments of shifting core elements – not entirely under the control of the individual. Learning (defined as actionable knowledge) can reside outside of ourselves (within an organization or a datable), is focused on connecting specialized information sets, and the connections that enable us to learn more are more important than our current state of knowing."*

This way, games can provide new opportunities to create distributed knowledge networks, peer-mentorship and sharing of information. Knowledge networks and communities of practices that enable the interconnectedness between learners are some examples of the applicability of this theory.

Together, these learning theories sets the recommendations for designing digitally-mediated learning tools that can affect the learning experience. It is worth mentioning that although some studies (Suter, 2011) criticize the use of 'learning styles' and classify them as a 'neuromyth', this thesis follows a holistic approach by intertwinning theories with the context observed and not each theory *per se*. Beyond the neurobiology of the learner, the sociocultural context is also important.

2.4 E-learning in later adulthood

A large and growing body of literature (Allen, 2011; McNeely, 1991; Yousef, Chatti, Schroeder, & Wosnitza, 2014) investigates the topics of computer-assisted learning, online courses, and massive open online courses. Indeed, there is a consensus among researchers (Githens, 2007; McNeely, 1991) that these learning programmes bring such advantages as enabling self-learning and learning at one's own pace. However, most of the platforms do not seem prepared for older adult learners (i.e. the courses do not have a short time duration and only one type of media is frequently used to transmit lectures, among others).

Only a handful of studies (Githens, 2007; Günther, Schäfer, Holzner, & Kemmler, 2003; McNeely, 1991; Ryu, Kim, & Lee, 2009) have addressed online courses and the ageing process. Among these studies, a quasi-experimental one was carried out by McNeely (1991) with 120 older adults aged between 60 and 89 regarding the effectiveness of computer-assisted instructions. The study has found that computer-assisted instructions were effective for learning and developing a positive attitude towards computer lessons. Moreover, in an analysis of computer-assisted training and long-term improvements in cognitive performance, Günther, Schäfer, Holzner and Kemmler (2003) have found significant improvements in working memory, processing speed and learning in a group of 19 older adults aged 75 and over. Other studies have been published on the identification of accessibility issues (Sanchez-Gordon & Luján-Mora, 2013; Stoltz-Loike, Morrell, & Loike, 2005) and the potential (barriers and benefits) of online courses (Bakaev, Ponomarev, & Prokhorova, 2008). There is, however, a general lack of research (Costa & Veloso, 2016b) in the development of these digital platforms that address learning and changes in behaviours in later adulthood.

The following Table (Table 06) is an account of some examples of these platforms and courses used that took into account, either, usability and accessibility issues or the needs, context and motivations of the older adult learner. As can be seen from Table 06, there is few reported cases in the development of online courses addressed to adult learners aged 50 and over. In addition, the majority seem to: (a) not involve the target group in the design process; and (b) focus on providing computer skills.

Overall, these studies highlight the need for developing effective learning-based tools for active ageing. The next Chapter covers three examples of these distance learning-based tools: game-based learning, serious games, and gamification artefacts.

Table 06. Examples of the use of e-learning platforms in later adulthood (Costa & Veloso, 2017)

Designation	Description
1. Virtual-reality to encourage older pedestrians' safety	This virtual-reality programme is designed to train older pedestrians in how to make safer decisions in situations of two-way traffic. This experiment involved both a full-scale and a small-scale simulation device (Maillot, Dommès, Dang, & Vienne, 2017)
2. BusinessThinking	This e-learning platform (CD-ROM) aims to teach adult learners aged 50 and over to develop technology and career development skills by including such modules as: Internet search engines, Excel, PowerPoint, Word Revision function and Career Development (Stoltz-Loike et al., 2005).
3. Simulated Driving in Older Adults	Driving Simulator that trains such different skills as 'divided attention, visual-spatial working memory and manual control'(Cassavaugh & Kramer, 2009, p. 2044). The tasks were: 'car-following single task, memory single task, monitoring single task, car-following/memory dual-task, car following/monitoring dual-task' (Cassavaugh & Kramer, 2009, p. 2045)
4. E-learning for Tribal Elders	A cooperative e-learning management system that incorporates discussion forums, shared content, assignments, learning calendars, assessment and quizzes. Older adults are encouraged to upload their oral history and the platform fosters interaction between young and old members of a tribal community (Wan & Tsai, 2014).
5. E-learning literacy tutorials	An interactive-based tutorial to deliver eHealth literacy content (Watkins & Xie, 2014)
6. TAFCITY	An online course that presents a number of open-educational resources, communication and social networking tools. The learning content is divided into the following topics: 'outdoor spaces and buildings, transportation and housing; Respect, social inclusion and participation; Community and health services, employment, communication and information' (Andone & Vasiu, 2013, p. 68)
7. Unibook	A real-time training application with the following functionalities: Raise Hand, Public and Private Chat, Audio and video conferencing, Desktop sharing and shared whiteboard (Chimos et al., 2012)

Table 06. Examples of the use of e-learning platforms in later adulthood (Costa, & Veloso, 2017) *(cont.)*

8. eLSe-Academy	The eLSe-Academy (eLearning for Seniors Academy) is an e-learning platform that aims to provide older adult learners with skills related with the use of Information and Communication Technologies. (http://www.lernhaus.net/)
9. U3A Online	The U3A Online is an International University of Third Age that distributes a set of online courses in the following modalities: independent study and study with a tutor. The courses divide into the following categories: History and International Affairs, Nature, Writing and Creativity; Lifestyles and Science (http://www.u3aonline.org.au)
10. AARP Driver	This online course is related with driving strategies and road safety in later age (e.g. safe driving strategies, information on the effects of medication on driving) (http://www.aarp.safety.org/)
11. Colgate	This online course aims to create awareness about oral healthcare in later age (http://goo.gl/HSaMLz)
12. PlotProject.net	This online course covers the topic of healthy ageing and is divided into the following modules: physical activity, falls, alcohol and tobacco, diet and weight, chronic conditions and medical care, sleep & mind, social connections, optimism and adaptability. (http://www.plotproject.net/)

3 DIGITAL GAME-BASED LEARNING, SERIOUS GAMES AND GAMIFICATION   77
GAME-BASED LEARNING FOR ACTIVE AGEING
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3 Digital game-based learning, serious games and gamification[9]

«Father: […] but they [conversations] are a sort of game that we play together. // Daugther: Then, they're not serious.»

– Bateson (1972, p. 14)

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[9] Part of the content of this Chapter has been published in the following papers:

Costa, L. V., & Veloso, A. I. (2016). "Game-based psychotherapy" for active ageing: A game design proposal in non-game context. In *Proceedings of the TISHW 2016 - 1st International Conference on Technology and Innovation in Sports, Health and Wellbeing,* Vila Real, 1-3 Dec. 2016, USA: IEE, 1-8. Doi: https://doi.org/10.1109/TISHW.2016.7847788

Costa, L., & Veloso, A. (2016). Being (Grand) Players: Review of Digital Games and their Potential to Enhance Intergenerational Interactions. *Journal of Intergenerational Relationships*, *14*(1). Doi: https://doi.org/10.1080/15350770.2016.1138273

Costa, L., & Veloso, A. (2015). "The gamer's soul never dies: Review of digital games for an active ageing." In *Proceedings of the 2015 10th Iberian Conference on Information Systems and Technologies, Aveiro, 17-20 June 2015*.Ed. Rocha et al. USA: IEE, 2015 Doi: https://doi.org/10.1109/CISTI.2015.7170614

Costa LV, & Veloso AI. (2016). Factors influencing the adoption of video games in late adulthood: A survey of older adult gamers. *International Journal of Technology and Human Interaction*, 12(1). https://doi.org/10.4018/IJTHI.2016010103

Costa, L. V., Loizou, M., Arnab, S., & Veloso, A. I. (2017). *Games for Active Ageing, Wellbeing and Quality of Life: A Pilot Study*. In press

Costa, L. V., Loizou, M., Arnab, S., & Veloso, A. I. (2017). *Breaking barriers to game-based learning for active ageing and healthy lifestyles: A qualitative interview with experts on the field*. In press

Veloso A.I, Costa L.V. (2016) "Heuristics for designing digital games in assistive environments: Applying the guidelines to an ageing society." In: *Proceedings of the* TISHW 2016 - 1st International Conference on Technology and Innovation in Sports, Health and Wellbeing, Vila Real, 1-3 Dec. 2016, USA: IEE, 1-8. Doi: https://doi.org/10.1109/TISHW.2016.7847789

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3 Digital game-based learning, serious games and gamification

This Chapter discusses both the concepts of play, games, serious games and game-based learning. Sets of recommendations for designing digital games for encouraging active ageing and enhancing intergenerational interactions are provided. Finally, this Chapter delves into the concept of gamification and its potential for active learning.

During the past few years, more information has become available on the use of games in non-leisure contexts, specifically in learning and training (Kapp, 2012; Prensky, 2001). In fact, a number of authors (Abt, 1987; Gee, 2007; Huizinga, 2015; Prensky, 2001) have challenged us to (re) think the use of games as a form of popular culture to be intertwined with the learning process. However, such concepts as games, play, seriousness and learning have generally been either taken-for-granted or poorly discussed. Therefore, this section attempts to further our understanding relative to the concepts and the state-of-art of game-based learning, serious games and gamification for active ageing.

3.1 Defining play and games

Play and games have been subject to discussion in a wide range of fields (*e.g.* philosophy, sociology, linguistics, game studies...) and yet they are difficult concepts to define and distinguish precisely. These difficulties can be illustrated in Wittgenstein's

Philosophical Investigations (1953, as cited in Bloor., 2002) and Bateson's Steps to an Ecology of Mind (Bateson, 1972).

"For how is the concept of game bounded? What still counts as game and what no longer does? Can you give the boundary? No."

- Wittgenstein's Philosophical Investigations (1953, as cited in Bloor, 2002)

Although Wittgenstein refered to games in the language context, the difficulty in defining what a game is and the differences between play and games are widely discussed in different domains. For example, in Steps to an Ecology of Mind, Bateson (1972) draws our attention to the following dialogue between daughter and father:

"Daughter: Daddy, do our talks have rules? The difference between a game and just playing is that a game has rules.

Father: Yes. Let me think about that. I think we do have a sort of rules… and I think a child playing with blocks has rules. The blocks themselves make a sort of rules. They will balance in certain positions and they will not balance in other.

D: But what rules do we have?

F: Well, the ideas that we play with bring in a sort of rules. There are rules about how ideas will stand up and support each other. And if they are wrongly put together the whole building falls down.

D: No glue, Daddy?

F: No – no glue. Only logic"

- In Metalogue: About Games and Being Serious, Bateson (1972, p.17)

In this dialogue between daughter and father, the rules and boundaries (either physical or conceptual – "blocks' position", "logic) are suggested to be the key elements that distinguish games from play. Nonetheless, the confusion between the interlocutors persists to determine what a game and play are.

"F: [...] The point is that the purpose of these conversations is to discover the 'rules.' It's like life – a game whose purpose is to discover the rules, which rules are always changing and always undiscoverable.

D: But I don't call that a game, Daddy.

F: Perhaps not. I would call it a game, or at any rate 'play.' But certainly it is not like chess or canasta. It's more like what kittens and puppies do. Perhaps. I don't know."

- In Metalogue: About Games and Being Serious, Bateson (1972, p.20)

This passage illustrates that the word 'game' refers to a more structured and rule-based activity than play. Whereas play is either common in Humans or animals (Huizinga, 2015), games distinguish Humans from other animals.

According to Huizinga (2015), play is a free and unserious activity almost situated outside of everyday life. Indeed, he has pointed out that games and play are voluntary and a 'magic circle' is traced (either conceptually or physically) between the activity of playing/game-playing and daily routines.

In addition, the author proposes the term *homo ludens* to define playing and game-playing as both a biological and cultural activity (Huizinga, 2015).

From my point of view, the nature of being *homo ludens* may derive from the embodiment of other capacities that characterize the human being. Figure 13 shows the interrelation between homo ludens and other characteristics of the Human being that are encouraged through different game elements.

As shown in Figure 13, the human capacity of game-playing (*homo ludens)* can encompass the following characteristics of the Human specie (Herrero, 2011; Romeo, 1979):

- *Homo faber* refers to the human capacity to craft and act upon the environment. Games are action-oriented and they can be used for crafting, acquiring and training new skills;

- *Homo creator* is used by Nicolaus Cusanus to refer to the nature of Humans as God's creation. Modding (modification) culture in games enables the players to create their own environments (world-building);

Figure 13. Interrelation between homo ludens proposed by Huizinga (2015) and other characteristics of human beings that can be encouraged through different game elements

- *Homo riddens* refers to the human capacity to laugh. Fun is a crucial element in games that derive from the brain pleasure to discover patterns (Koster, 2013);
- *Homo curious* refers to the human capacity to inquire, inform and search information. Problem-solving in games implies searching for clues and interpreting the information presented;
- *Homo socius* refers to the human capacity to be socially engaged in groups. Social network games can bring players together and lead to the formation of communities of practice;
- *Homo duplex* refers to the human capacity to double face. Role-playing and game avatars may encourage this nature of the human being;
- *Homo imitans* refers to the human capacity to imitate others' behaviours (Herrero, 2011). Mimetic interfaces in games (*e.g.* Kinect Sports, Guitar Hero, Wii Fit) (Juul, 2012) stimulate learning through mimesis;
- *Homo mendax* refers to the human capacity to lie. In games, players may bluff;
- *Homo discens* refers to the human capacity to learn (Gardner, Cairns, & Lawton, 2000). Games may encourage experiential learning;

- *Homo oeconomicus* refers to the human desire to acquire and maximize wealth. Game activities often dealt with outcomes and management of resources;

- *Pan narrans* refers to the human capacity to tell stories (Benade, 2011). Games can involve players through the use of the narrative

- *Homo aestheticus* refers to the human capacity to feel and express emotions. Indeed, game designers can express feelings and emotions through game art.

In a nutshell, play and games are part of the Human nature by developing the individuals' intellectual, physical and social capabilities.

The author Caillois (2001, p. 63) defines play as "a parallel, independent activity, opposed to the acts and decisions of ordinary life by special characteristics appropriate to play." Those characteristics are: (a) being free and voluntary; (b) independent from everyday life; (c) uncertain – that is to say that the results are not predictable; (d) unproductive; (e) rule-based; and (f) embedded in an imaginary world towards 'real life.'

Caillois (2001) uses the term 'paidia' to define the unstructured and free activity of playing whereas 'ludus' refers to game-playing. In the latter case, the author divides games into the following taxonomies:

- *Agôn:* competitive games that involve feats of prowess (*e.g.* hunting, tornaments, duels…);

- *Alea:* games of chance, fate or superstition (*e.g. card games, dominoes*)

- *Mimicry:* simulation games that enable the players to build their own imaginary world (*e.g.* Dragons and Dungeons); and

- *Ilinx:* games that stimulate players ' actions, thrill and excitement (e.g. mountain climbing, football…).

Salen and Zimmerman (2003, p. 80) describe games as systems "in which players engage in an artificial conflict, defined by rules, that results in a quantifiable outcome." The authors also have compiled different game definitions proposed by a number of philosophers and game developers and the most cited characteristics relative to game-playing were: (a) proceed according to rules; and (b) be goal and outcome-oriented. Another important game characteristics were: have a conflict; be a voluntary

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activity/process/event; involve decision-making; and be artificial, safe or outside from ordinary life.

Beyond these game characteristics, they are also a medium of entertainment. According to Sayre and King (2010), entertainment can be experienced in different ways: (a) passively, (b) educationally, (c) in animersive and interactive way; and (d) aesthetically engaged. In addition, these experiences may vary over time.

Overall, games are part of the enterainment industry and a result of experience enconomy (Sayre & King, 2010). Indeed, the word 'entertainment' means 'holding attention' or 'agreeably diverting' and may report to either a live or mediated experience. Hence, even when games can be applied to a learning or training context, we should not neglect the main purpose of an entertainment medium (i.e. holding attention and be amusing). In the following section, game-based learning and serious games are discussed.

3.2 Serious games versus Game-based learning

Games can be a powerful media for training and learning (Abt, 1987; Gee, 2007; Kapp, 2012; Prensky, 2001). Indeed, Serious games and Game-based learning have been reinventing the way we learn and acquire new skills by providing new and active learning experiences. In addition, learning spaces have also become more personal through the use of learning objects and shared communities.

One question that needs to be asked, however, is whether games can be serious. As noted by Huizinga (2015), games are not the opposite of seriousness and thus, everyday experiences can include game thinking and playful elements.

In Metalogue: About Games and Being Serious, Bateson (1972, p. 14) highlights the need for clarifying these concepts by presenting the following dialogue between daughter and father:

> *"F: Suppose you tell me what you would understand by the words 'serious' and a 'games.'*
> *D: Well… If you're… I don't know.*
> *F: If I am what?*
> *D: I mean… the conversations are serious for me, but if you are only playing a game...*

*F: Steady now. Let's look at what is good and what is about 'playing' and 'games.'
First of all, I don't mind – not much – about winning or losing. When your questions
put me in a tight spot, sure, I try a little harder to think straight and to say clearly
what I mean. But I bluff and I don't set traps. There is no temptation to cheat.*

*D: That's just it. It's not serious to you. It's a game. People who cheat just don't
know how to play. They treat a game as though it were serious.*

F: But it is serious.

D: No, it isn't – not for you, it isn't.

F: Because I don't even want to cheat?

D: Yes – partly that."

- In Metalogue: About Games and Being Serious, Bateson (1972, p.14)

In this part of the dialogue, Serious games are seen as an attitude of doing everything
(even cheating) to win the game. Hence, this passage arises the following question: "Can
games be serious or is the way that we play that can be serious?"

In response to the aforementioned question, the author Clark Abt (1987, p. 9) writes:

*"Games may be played seriously or casually. We are concerned with Serious games
in the sense that these games have an explicit and carefully thought – out
educational purpose and are not intended to be primarily for amusement. This
doesn't not mean that Serious games are not, or should not be, entertaining."*

From my point of view, Abt (1987) begins the sentence by referring to the activity of
game-playing that can be serious or not. Then, he changes his perspective to refer to the
artefact elements. The author (1987, p.11) goes on saying:

*"Serious games unite the seriousness of thought and problems that require it with the
experimental and emotional freedom of active play. Serious games combine the
analytic and questioning concentration of the scientific viewpoint with the intuitive
freedom and rewards of imaginative, artistic acts."*

By contrast, Rockwell and Kee (2011) does not believe that games can be considered as 'serious' and he evokes one of the characteristics used to define game playing, which is considered to be 'unserious' activity. Another problem with 'serious games' is the use of the term 'seriousness', which has been criticised over the years.

For example, Samuel Butler (McGuire, Boyd, & James, 1992, p. 77) points out: "The one serious conviction that a man should have is that nothing is to be taken too seriously."

Despite this, other authors (Djaouti, Alvarez, Jessel, & Rampnoux, 2011) have suggested that there are sets of game elements that distinguish serious games from games. These elements are: pedagogy, human performance, pedagogy subordinate of story, working relationships, gameplay, purpose and scope (Djaouti et al., 2011).

In terms of the domains that Serious games can be applied, Sawyer and Smith (2008, as cited in Krans, 2012, p. 7) have presented the Serious Game Taxonomy, divided into two dimensions: content and sectors. In terms of 'Games for Health and Education' applied to the Education Sector, the main purposes can be: Provide Information about diseases/risks; and Learning. As in this thesis, the content vary between Health and Education and the sector is Education, a game-based learning approach is followed.

Before proceeding to examine the potential of game-based learning for active ageing, it is necessary to clarify the concept. Although it has been widely spreaded in the areas of education and game studies (Baek & Whitton, 2013; Prensky, 2001; Van Staalduinen & De Freitas, 2011), there is not yet a precise definition of the term.

The authors Connolly, Stansfield and Hainey (2007, p. vi) suggest that game-based learning may be defined as "the use of a computer games-based approach to deliver, support, and enhance teaching, learning, assessment and evaluation." However, such explanations tend to overlook the fact that the game-based learning is not only the mixing of the game concepts with the learning component.

According to Prensky (2001), there is a clear distinction between Pure games, computer-based training (CBT)/e-learning/Computer-assisted learning program and Digital game-based learning (DGBL). The distinction is based on the following criteria: (a) the level of gameplay/engagement; and (b) the level of learning. If both criteria are high, the result is a game-based learning product. If the level of gameplay/engagement is high but the level learning is low, the result is a pure game and whether both levels of engagement are low, the result is computer-based training.

In terms of the differences between serious games and game-based learning, the latter is a type of serious game. Whereas serious games may include training, advergames, production, among other types of games, game-based learning is structured around learning objectives, outcomes, assessment, learning pace, learners' skills and transference of game skills to the physical environment.

Indeed, digital game-based learning can be a useful supplement to more traditional non-game systems by providing simulated experiences in which learners can apply their knowledge and have an immediate feedback on their actions.

The author Gee (2007) lists thirteen learning principles that a game-based learning approach should follow. Figure 14 shows the learning principles proposed by Gee (2007) linked to different learning theories.
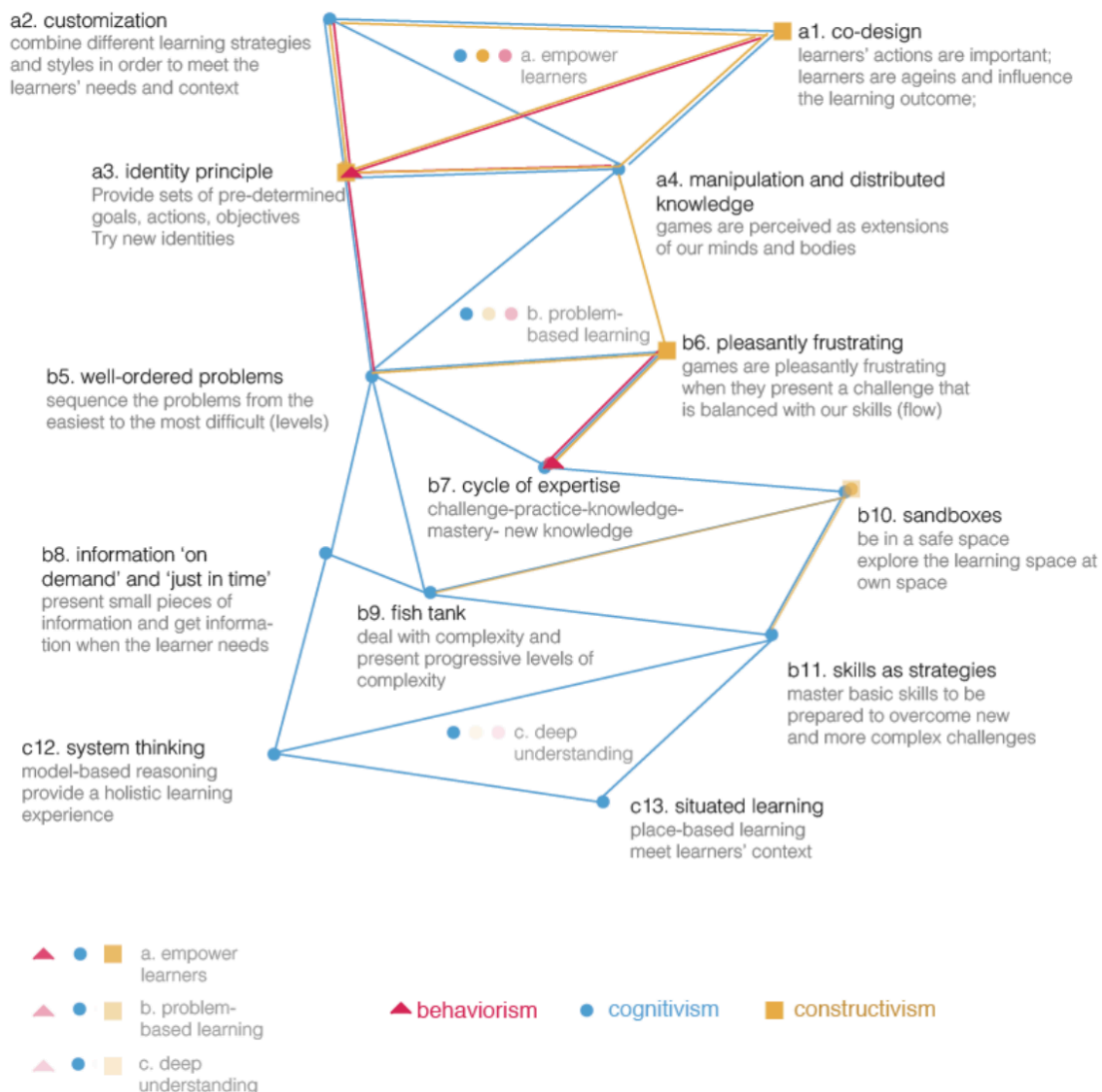
Figure 14. The learning principles proposed by Gee (2007) linked to different learning theories

As shown in Figure 14, Gee (2007, p.30) divided the learning principles in games into the following categories: (a) empower learners; (b) problem-based learning; and (c) deep understanding. These principles are explained below and assigned to the learning theories previously discussed in Chapter 2.

A. Empower learners

This category encompasses the following principles: (a1) *co-design*; (a2) *customization*; (a3) *identity principle*; and (a4) *manipulation and distributed knowledge*.

a1. *Co-design*: Learners are active constructors of their knowledge and learning is driven by personal discovery. From my point of view, this principle is linked to the constructivism theory;

a2. *Customization*: Learners can combine different learning strategies and styles in order to meet their own preferences. This principle is suggested to be linked to cognitivism (situated cognition, attribution theory);

a3. *The identity principle*: Learners should know the reasons for learning and have access to a set of learning goals and rules. Games are good to provide a purpose and enable learners to try new identities. This principle is suggested to be related with behaviourism (GOSM model);

a4. *Manipulation and distributed knowledge*: Games are perceived as extensions of the mind by enabling learners to interact with the digital environment. The principle is suggested to be related with cognitivism.

As 'Empowering learners' often deals with both learners' behaviours, cognition and their participation in the learning process, this category seems to not have a dominant theory.

B. Problem-solving

This category encompasses the following principles: (b5) well-ordered problems; (b6) pleasantly frustrating; (b7) cycle of expertise; (b8) information 'on demand' and 'just in time'; (b9) fish tank; (b10) sandboxes; and (b11) skills as strategies.

b5. *Well-ordered problems*: Learning problems should be presented sequentially from the easiest to the most difficult to solve (game levels). This principle is suggested to be linked to cognitivism (problem-based learning);

b6. *Pleasantly frustrating*: Games are pleasantly frustrating when challenges are balanced with the learners' skills. The principle is suggested to be linked eitheir to cognitivism or construtivism (flow);

b7. *The cycle og expertise*: The cycle of expertise encouraged in games is based on the following elements: challenge, practice, knowledge, mastery, and new knowledge. This principle is suggested to be linked to both cognitivism and behaviourism (operant conditioning);

b8. *Information 'on demand' and 'just in time'*: Information should be presented to learners when they need in order to be meaningful. This principle is suggested to be linked to cognitivism;

b9. *Fish thank*: Provide tutorials and easy levels of difficulty in order to progressively advance on complex tasks and more challenging activities. The principle is suggested to be linked to cognitivism (attribution theory);

b10. *Sandboxes*: Games are safe environments that can be explored at the learners' pace. This principle is suggested to be linked to constructivism (discovery learning);

b11. *Skills as strategies*: Learners can only advance to the most difficult levels when they have mastered the skills needed during the basic levels. The principle is suggested to be linked to cognitivism (ARCS model).

C. Deep understanding

This category encompasses the following principles: (c12) system thinking; and (c13) meaning as action image.

c12. *System thinking*: Learners should understand the whole learning system they are in (pre-determined goals, outcomes, the transference of the knowledge provided to other context, among others). The principle is suggested to be linked to cognitivism (cognitive apprenticeship) and behaviourism (GOMS model);

c13. *Meaning as action image*: The process of learning is dependent on the individual's context, interaction with others and shared activities. In games, abstract reasoning comes out from the reconstruction of experiences. This principle is suggested to be linked to cognitivism, constructivism and connectivism (situated learning).

In the categories 'Problem-solving' and 'Deep understanding', cognitivism seems to be the most predominant theory. One reason why this happens may be that information design is fundamental to the effectiveness of learners' cognition (attention, memory, capacity of problem-solving, decision-making...). Hence, game-based learning tends to be effective when pieces of information are presented in such a way that learners can attribute meaning and translate it into knowledge.

3.3 Digital games for encouraging active ageing

In the Information and Communication Society, the perception of active ageing and intergenerational communications are often threatened by the digital divide (Aarsand, 2007) and disparities in authority of child – (grand) parents' relationships (Mesch, 2006).

Although parents tend to trust in grandparents to provide childcare, geographic distance (Harwood, 2007; Harwood & Lin, 2000; Uhlenberg & Kirby, 1998) and parents' divorce (Drew & Smith, 2002) are likely to affect the quality of intergenerational relationships. Therefore, digital games can incite an episodic interaction and the dialog between younger and older generations.

In *Being (Grand) Players: Review of Digital Games and their Potential to Enhance Intergenerational Interactions* (Costa & Veloso, 2016c), games are suggested to foster intergerational interactions by contributing to individual wellbeing, prosocial behaviours, and sharing of knowledge; providing a communal activity and balancing both users' skills and challenges. Game designers should, therefore, take into account the following recommendations: prioritize physical, mixed-reality games and multimodal interactions; prioritize peer-to-peer mentoring, collaboration, scaffolding and learning; enabling social interactions, shared context, and meeting places; and providing an easy-to-use interface and adaptable game controllers.

In addition, several studies (De Schutter & Vanden Abeele, 2008; Derboven, Van Gils, & De Grooff, 2012; Gamberini et al., 2009; Gamberini, Barresi, Maier, & Scarpetta, 2008; Ijsselsteijn, Nap, de Kort, & Poels, 2007; Loos, 2014; Nap, De Kort, & IJsselsteijn, 2009; Whitlock, McLaughlin, & Allaire, 2012) have found that games can be beneficial to active ageing in a number of important ways. For example, they can: (a) Improve cognitive functioning (Whitlock et al., 2012); (b) Train learners' memory and encourage social interactions (De Schutter & Vanden Abeele, 2008; Derboven et al., 2012; Gamberini et al., 2009, 2008; Ijsselsteijn et al., 2007); (c) Challenge the thinking process, exercise hand-eye coordination; and (d) Positively influence the learners' self-concept, self-esteem and quality of life (Gamberini et al., 2009; Loos, 2014; Pires, 2011; Raessens & Goldstein, 2011).

In *Factors Influencing the Adoption of Video Games in Late Adulthood: A Survey of Older Adult Gamers* (Costa & Veloso, 2016b), a survey to 245 gamers aged 50 and over has revealed that adventure games with Problem-solving were prefered, followed by Strategy and Memory games. In terns of the skills that the participants would like to practice, Problem-solving, Spatial and Temporal Memory skills and Calculation were the most cited. A set of design decisions should be taken into account as the ones that are identified in the publications entitled *The gamer's soul never dies: Review of digital games for an active ageing* (Costa & Veloso, 2015): get the player familiar with the interface; enable collaboration and social connection among players; follow a set of usability and accessibility guidelines; and use digital games to train cognitive skills.

Designing games as assistive environments should also embody the following characteristics: be customizable (adaptive); and maintain (assist), increase or improve (rehabilitate) the capabilities of an individual (Veloso & Costa, 2016).

However, very little attention has been paid to be the benefits of games to other variables of active ageing than health (i.e. sense of security and participation in society). In this sense, a game-based psychotherapy model is proposed based on the cognitive behaviour therapy (Beck, 1960, as cited in Beck, 2011)(Figure 15).
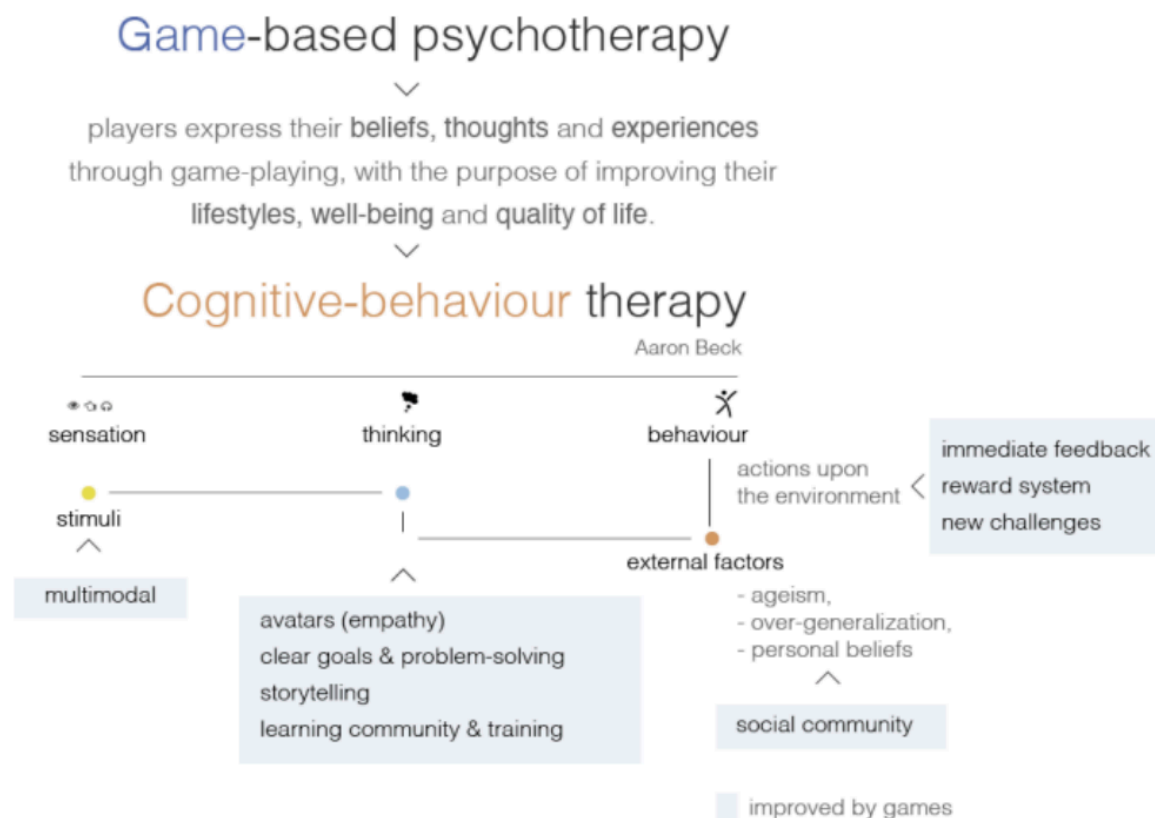
Figure 15. Scheme representing the proposal of Game-based psychotherapy (Costa & Veloso, 2016a)

A 'Game-based psychotherapy' is a term that stems from the cognitive-behaviour therapy (Beck, 2011) and it is used to refer to the willingness that players have in order to express their beliefs, thoughts, and experiences through game-playing, with the purpose of improving their lifestyles, wellbeing and quality of life. Hence, the following elements should be considered (Costa & Veloso, 2016a):

- *Sensation:* The way environment is sensed (*e.g.* auditory, visual or tactile signs) is crucial to changes in behaviours. Digital games can activate external stimuli and provide multiple modes of interaction with the environment;

- *Cognitive process (thinking):* After sensation, signs are perceived. Digital games can have an impact on the players' perception towards the environment through the use of simulation scenarios, avatars (empathy), clear goals, problem-solving or learning/training communities;

- *Behaviour:* Behaviours consist of someone's actions upon the environment. These actions can be influenced by external factors (Veloso & Costa, 2015) (*e.g.* ageism, over-generalisation or personal beliefs). Digital games can provide immediate feedback on someone's actions and motivate individuals through intrinsic and extreinsic rewards and new challenges.

In view of the aforementioned recommendations for developing digital games for encouraging active ageing and the use of games in psychotherapy, a game-based tool should take these into account in order to adress behavioural changes and have an impact on the end-users' daily life and contribute to their wellbeing and quality of life. The next section introduces the use of game thinking in daily-life experiences and learning. This technique is called 'gamification.'

3.4 Gamification and active learning

The concept of gamification (game + modification) has evolved since Nick Pelling has founded the enterprise Conundra, aiming to turning electronic devices into more game-like. Although there is not a consensus towards the real meaning of gamification, there seems to be an agreement that gamification encompasses game elements or strategies and its application in non-game contexts (Werbach & Hunter, 2012).

According to a definition provided by Elias, Rajan, McArthur, and Dacso (2013, p. 7), gamification is 'the use of game design techniques and mechanics to engage audiences and improve behavior-related outcomes.'

Three main characteristics that define gamification seems to be 'game thinking', 'game elements' and 'context' (Kapp, 2012; Werbach & Hunter, 2012; Zichermann & Cunningham, 2011). So far, however, there has been little discussion about the differences of games, gamification and playful design.

Deterding, Dixon, Khaled and Nacke (2011) compared gamification to serious games and playful interaction. According to them (2011), serious games are different from gamification in terms of completeness.

Whereas Serious games embodies sets of game elements (*e.g.* goals, challenge, rewards, rules), gamification defragments these elements. Both serious games and gamification are applied to non-leisure contexts.

By contrast, playful design and interaction are related with play. Google doodles is one example of playful interaction.

Difficulties arise, however, when an attempt is made to distinguish serious games and gamification as both are applied to non-leisure contexts. If, on the one hand, serious games embed more game elements than gamification, on the other hand, that fact leads to questions about immersion in gamification.

Another question that one may pose is whether serious games are a product or a process and whether they can be compared with such process as gamification.

In my perspective, what differentiates gamification, playful design and game-design are the main inputs that serve these processes. Figure 16 illustrates these differences.

As shown in Figure 16, gamification, playful and game design are processes in which tedious and boring tasks become fun. They are different in terms of their input/context: activity, inanimate object or simulation.

Gamification processes have been applied in the following contexts (Werbach & Hunter, 2012): (a) external (*i.e.* marketing, sales); (b) internal (*i.e.* human recruitment, productive enhancement, crowdsourcing); and (c) behaviour change (*i.e.* health, habits, participation in society).

In this thesis, the process of gamification is applied to changes in behaviour. Indeed, behaviour-related outcomes may be due to game thinking and problem-solving capacity.

Glass, Maddox and Love (2013) have found that game-playing environments can have a role in training cognitive flexibility, which is fundamental to the adaptation and decision-making about real-life problems and new situations. Thus, gamification can also be significant for changes with social and psychological impacts.

For example, the initiative of 'Games for a change' encourages the development of games to serve humanitarian and educational causes. This process of transference of game thinking into real-world environment is made through motivation and the self-

determination theory (Deci & Ryan, 2002; Rigby & Ryan, 2011), which has been explained in Chapter 2.
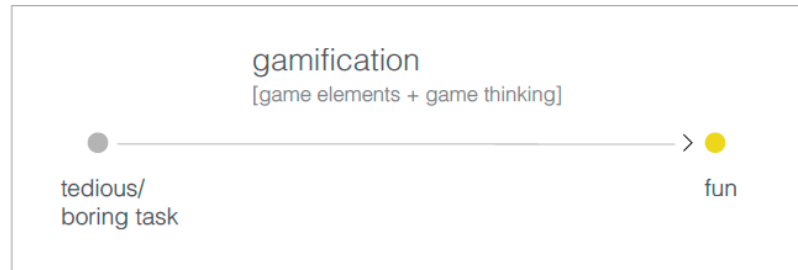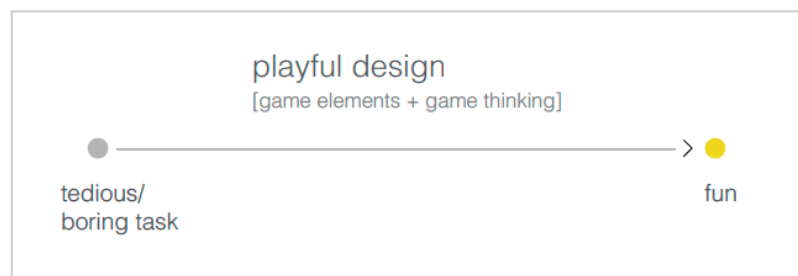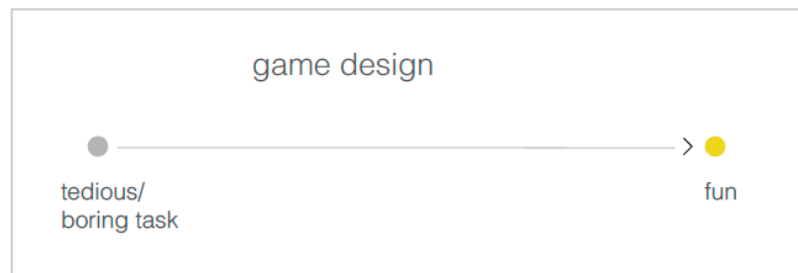
Figure 16. Gamification, playful design and game design

Gamification has also been applied to encourage health habits. Nike+ and Health Month are some of the examples of gamified systems that aim to improve players' fitness, diet, cognition and social relationships. However, there are other contexts in which gamification cannot work. For example, it is discouraged in emergencies, situations that deal with legal or ethical problems, privacy or even highly motivated tasks (Werbach & Hunter, 2012).

In addition, a common misconception towards gamification is Pointification – the sole use of PBL (Points, Badges and Leaderboards) without a strategy or a purpose. A good gamification system also implies game design techniques beyond game elements.

In other words, gamification is more than a reward system. Indeed, game elements should be interrelated to the goal, conflict, rules and challenges presented. Similarly, good gamification systems take into account the players' motivations and context.

Regarding active learning, understanding "What makes things fun to learn?" (Malone, 1980) and matching the gamification elements to the learners' context and needs are fundamental. Figure 17 shows the main game-based elements that captivate learning according to Malone (1980) and that are linked with the gamification mechanics presented by Kapp (2012), Zichermann and Cunningham (2011), Zichermann and Linder (2013) and Werbach and Hunter (2012).
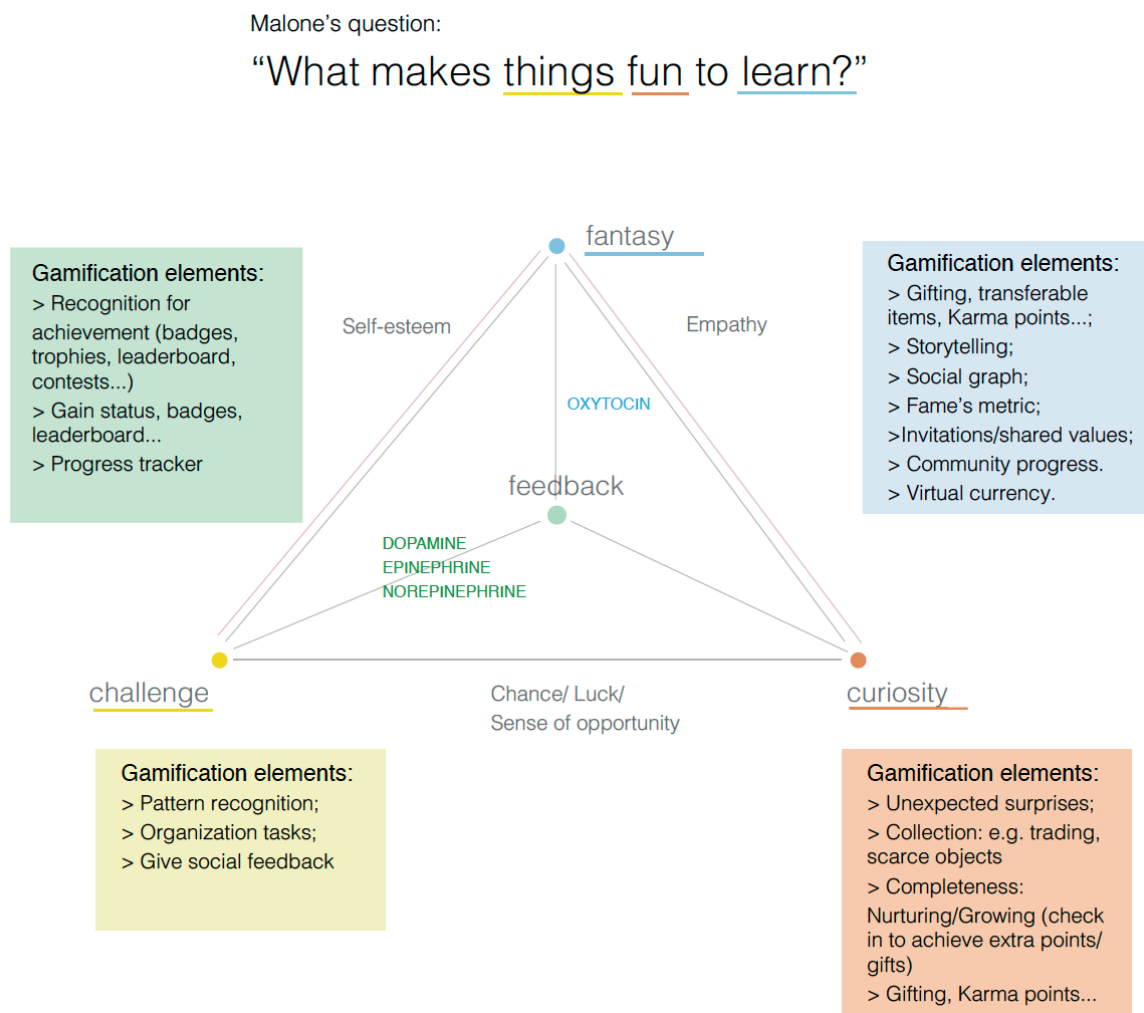
Figure 17. Gamification mechanics and learning

According to Malone (1980), the main components that make games and learning enjoyable are: challenge, fantasy, and curiosity. Thus, it is necessary to clarify exactly what is meant by each concept (Malone, 1980):

- *Challenges* are related with a sense of mastery and progression towards uncertain goals and some randomness;
- *Fantasy* is based on schemas and representations from previous experiences;
- *Curiosity* is related to an optimal level of complexity of the learning environment. Indeed, the learning environment should be novel and surprising but not too complex.

The author Malone (1980) also points out that the concepts of 'challenge' and 'curiosity' should be treated separately. However, when players perceive luck, chance or cultivate a sense of opportunity, challenges may be linked with curiosity.

In the same vein, self-esteem result from a challenge with fantasy (Malone, 1980) and stems from fantasy with curiosity.

In my perspective, the feedback element should be added. Indeed, the elements presented by Malone do not work alone and they are fuelled by feedback (see Chapter 2). The combination of these elements can activate the neurotransmitters that play an important role in motivation, internal reward (ephinephirne, norepinephirne and dopamine) and emphatizing capacity (oxytocin) (McGonigal, 2011).

In terms of the gamification elements, they were subdivided into the following categories (Kapp, 2012; Werbach & Hunter, 2012; Werner, Carlson, Jordan-Marsh, & Clark, 2011; Zichermann & Cunningham, 2011; Zichermann & Linder, 2013):

- *Challenge*. Pattern recognition, organisation tasks and social feedback tend to be stimulating for the player's brain. For example, the *Match-three* or *Dinner Dash* games are based on pattern recognition and organisation tasks, which triggers brain's activity. Social feedback and helping others can be also internally motivating (McGonigal, 2011);

- *Curiosity:* Curiosity is triggered by unexpected surprises and events. The collection of objects (exploration, scarce objects...), gifting, karma and extra points for each check-in are some examples (McGonigal, 2011);

- *Fantasy:* Fantasy is mainly triggered by a storyline. Other elements that can contribute to fantasy are avatars, social graphs, fame's metric, invitations and shared values in communities, virtual currency, community progress, gifting, transferable items and Karma points.

- *Feedback:* Feedback is essential for providing information regarding the players' performance. As mentioned in Chapter 2, immediate feedback is important for encouraging a habit that will lead to a positive outcome. Badges, leaderboards, progress trackers and points are some of the elements that can provide feedback on the players' actions.

Overall, games can function as a call to solve daily-life problems by transferring some of the game techniques to trigger intrinsic motivations and, thus, learn and improve behaviour-related outcomes. The transference of game thinking into daily-life context seems to be more effective than the merely transference of game elements (*e.g.* badges, leaderboards and points) to the learning environment.

The next Chapter moves on to describe in detail the use of technologies for behavioural change and active ageing.

4 Designing for behavioural change and active ageing[10]

«Reality: what a concept!»

– Robin Williams (Parker, 1994, p. 37)

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[10] Part of the content of this Chapter has been published in the following papers:

Costa L.V., Veloso A.I., Mealha Ó. (2017) A Review of Proxemics in `Smart Game-Playing'. In Ó Mealha, M. Divitini, M. Rehm (Eds.) Citizen, Territory and Technologies: Smart Learning Contexts and Practices: *Proceedings of the 2nd International Conference on Smart Learning Ecosystems and Regional* Development - University of Aveiro, Portugal, 22-23, Cham: Springer International Publishing; 2018. p. 219–26. doi: http://dx.doi.org/10.1007/978-3-319-61322-2_22

Costa LV, Veloso AI. (2017). Demystifying Ageing Bias Through Learning. In: Beck D, Allison C, Morgado L, Pirker J, Khosmood F, Richter J, et al. (Eds.), *Immersive Learning Research Network: Third International Conference,* iLRN 2017, Coimbra, Portugal, June 26-29, 2017, Cham: Springer International Publishing; 2017. p. 201–13. Doi: http://dx.doi.org/10.1007/978-3-319-60633-0_17

Costa, L. V., & Veloso, A. I. (2017). Co-Designing a Game-Based Learning Platform for Active Ageing: The Case of "Jump." In *GAME-ON'2017, 18th Annual Conference on Simulation and AI in Computer Games*. In press.

Costa, L. V., & Veloso, A. I. (2016). "'Game-based psychotherapy' for active ageing: A game design proposal in non-game context". In *Proceedings of the TISHW 2016 - 1st International Conference on Technology and Innovation in Sports, Health and Wellbeing, Vila Real, 1-3 Dec. 2016,* USA: IEE 2016, 1-8. Doi: https://doi.org/10.1109/TISHW.2016.7847788

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4 Designing for behavioural change and active ageing

In this Chapter, the design process of technologies for wellbeing and quality of life is explored. In particular, emotional and behavioural design, the use of proxemics in smart game-playing and the co-designing process.

4.1 Emotional and behavioural design

There has been a growing interest in studying the role of emotions and behaviours for developing technologies that have an impact on the end-users' wellbeing and quality of life (Amichai-Hamburger, 2009; Calvo & Peters, 2014). Along with recent developments in Artificial Intelligence and Sentimental Computing Analysis, such market solutions as *Amazon Alexa*[11] and *First Home Olly*[12] are examples that show the potential of the system to recognize emotions, be aware of the users' context and react accordingly (Khan & Lawo, 2016).

If traditionally end-users were seen as merely as cognitive and physical processors and there was a dualism between machines and humans, nowadays the emotional aspects, different types of pleasures and the psychological wellbeing of the end users have become central to design interfaces (Jordan, 2000).

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[11] Amazon Alexa is a virtual assistant in which the user interacts with it through voice and depending on his/her context, Alexa can react by playing music, making to-do lists, setting alarms, playing audiobooks and providing real-time information.

[12] Olly is a home robot that adapts to the end-users by assisting him/her with daily routine and habits.

According to Jordan (2000), such dehumanizing perspective on the role of the end-user as a physical and cognitive processor that overlooked their emotions has evolved to the use of a Human-Factor specialist in order to mediate the interaction of the users with interface design. In fact, the user-friendly computer *Apple* was a big step towards introducing direct command lines for executing, methaphors and icons and in that way, levelling up the concerns of HCI specialists from functionality to usability and pleasure.

Four types of pleasures can be associated to a product (either techonology- mediated or not). These are (Jordan, 2000):

- *Physio-pleasure*: This type of pleasure can be sensed though the use of visual (*e.g.* animations, graphics…), auditory (speech sounds, frequency), olfactory (smell declines), gustatory (flavors) or somatic perception (tactile – touch, haptic – temperature, pressure or pain; kinesthetic – motion, force, body, limb movement). These pleasures often derive from physical environment and body personalization;

- *Socio-pleasure*: This type of pleasure stems from social identity (codes and conventions, status) and relationship with others;

- *Psycho-pleasure:* This type of pleasure often derive from cognitive-emotional reactions (*e.g.* moods, self-confidence, dreams, aspirations…); and

- *Ideo-pleasure:* This type of pleasure often derive from personal ideologies and the view of products as an art form.

Similarly, Norman (2004) reports that there are three levels in which design can have an impact on the end-user's emotions: visceral that is based on the product's appearance and rely on rapid judgements and human's senses; behavioural that refers to the pleasure and experience of use; and reflective that acts at a conscious level and expresses through self-image, personal satisfaction and memories.

It is worth mentioning that although a large and growing body of literature has investigated emotional and affective experiences towards Human-Computer interfaces (Ng, Khong, & Thwaites, 2012; Norman, 2004; Picard & Picard, 1997; Zvacek, 1991), most of the studies do not clarify the concepts. Drawing on the Spinoza studies, Damásio (2003) points out that affect embodies motivation, emotions and feelings. Indeed, emotions are different from feelings in a number of important ways. Whereas emotions can be defined as states of being, actions or movements that are visible to others (*e.g.* face

expression, tone of voice and behaviours), feelings are an idea of the body [or mind, in the case of affective feeling] when it is perturbed by emotions (Damasio, 2003).

In addition, a number of models and theories have been proposed to understand the use of moods and perceived emotions in interaction design. For example, the Tellegen – Watson – Clark model (Yang & Lee, 2004) maps emotions based on the following main domains: Low Negative Affect (*i.e.* at rest, calm, placid, relaxed), High Positive Affect (i.e. active, elated, enthusiastic, excited, peppy, strong), High Negative Affect (*i.e.* distressed, fearful, hostil, jittery, nervous, scornful) and Low Positive Affect (*i.e.* downsy, dull, sleepy, sluggish). Other variables mediate each two-pair domain: Pleasantness that is between Low Negative and High Positive Affect (*i.e.* content, happy, kindly, pleased, satisfied, warmhearted); Strong Engagement that is between High Positive Affect and High Negative Affect (*i.e.* aroused, astonished, surprised); Unpleasantness between High Negative Affect and Low Positive Affect (*i.e.* blue, grouchy, lonely, sad, sorry, unhappy), and Disengagement between Low Positive Affect and Low Negative Affect (*i.e.* quiescent, quiet, still).

According to the 'Appraisal Theory of Emotions', Humans are driven by different cognitive appraisals that are dependent on the relation between users' emotion and their environment. These are the different appraisal themes (Ellsworth & Scherer, 2003; Smith & Ellsworth, 1985): Pleasantness (valence); Responsibility/Control; Certainty about the outcomes; Effort and Perceived control (agency).

Furthermore, there is the Belief-Desire-Intention model that is used to programme intelligent agents relying on the following variables: belief that is associated to the knowledge of the agent; the desire that represents the agent's goal and finally the intention that is associated to the priority in which the different tasks are undetaken (Rao & Georgeff, 1995).

In general, the focus of these theories have been on virtual tutors, conversational agents and robots. However, these are not sufficient when designing for changes in behaviour and the main implications for designing learning environments (Table 07).

As can be seen in Table 07, there are a number of implications for designing learning environments based on different behavioural change theories (Glanz, Rimer, & Viswanath, 2008; Michie, Van Stralen, & West, 2011; Wendel, 2013). For example, if the health behaviours are influenced by the perceived seriousness of a problem and the comparison

between the benefits in terms of the barriers, the designer should inform about the potential benefits of that behaviour and simulate scenarios in which the seriousness of the problem can be experienced.

Table 07. Implications for designing learning environments with impact on health-behaviour changes

(Costa & Veloso, 2017)

Behavioural change theories	Implications for designing learning environments
1. *Health belief model:* health behaviours are influenced by the perceived seriousness of a problem and the potential benefits of a change when compared to barriers	a. Inform the target group about the potential benefits of change in behaviour b. Simulate scenarios in which the seriousness of the problem is presented
2. *Transtheoretical model:* the individual goes into different phases of change (i.e. pre-contemplation, contemplation, preparation, action and maintenance)	a. Reduce the perceived cost of taking an action ('progression to mastery' strategy) b. Present 'step-by-step' challenges
3. *Relapse prevention:* minimize lapses in changes in behaviours by promoting cognitive and behavioural coping strategies	a. Reward the target group when they achieve a goal b. Provide alternative coping strategies as exercises
4. *Information Processing:* the information is transformed based on the previous knowledge, coded and can be retrieved in response to different types of cues	a. Provide different types of cues (e.g. visual, auditory) to be associated to actions and daily habits/routines b. Provide easy-to-remember information
5. *Social cognitive theory*: As individuals believe that they are capable of changing their behaviours (self-efficacy), they are more willing to perform them	a. Link the information with previous knowledge/ past experiences b. Remind of prior successes ("small wins")
6. *Theory of reasoned action*: Change in behaviours are a result of individual's intentions that is both affected by attitudes towards the behaviour and the 'social pressure' to engage in the behaviour or not.	a. Turn the challenges/actions socially rewarding (e.g. invitation from friends, group tasks, events…) b. Promote social accountability
7. *Social support*: Social relationships can have an impact on health, wellbeing and changes in behaviour.	a. Provide an example for the target group to imitate (social modelling)
8. *Community organisation model*: Social communities can have an impact on health, wellbeing and changes in behaviours.	a. Build a trust network b. Build a social status towards changes in behaviours (e.g. *ranking*)

Table 07. Implications for designing learning environments with impact on health-behaviour changes

(Costa & Veloso, 2017) *(cont.)*

9. Ecological models: Environments and policies that support healthful choices can positively affect changes in behaviour	a. Inform about current policies and initiatives regarding that change in behaviour b. Provide context-aware information
10. *Organizational change:* Institutions create awareness and encourage changes in health behaviours	a. Build a long-term relationship with the institutions that can create awareness and encourage changes in health behaviours
11. *Diffusion innovation:* The dissemination of programmes and innovative ideas in health promotion can also encourage changes in behaviours.	a. Spread the message using media

In general, these are the following design recommendations that are suggested in order to meet the different behavioural change theories (Glanz et al., 2008): Simulate scenarios in which the seriousness of the problem is presented and inform about the change benefits; Enable scaffolding; Reward goal achievements; Provide alternative coping strategies; Associate different types of cues to actions and daily habits/routines; Provide easy-to-remember information; Link the information with previous knowledge/ past experiences; Remind "small wins"; Promote social accountability; Enable social modelling; Build a trust network and a social status; Inform about policies/initiatives; Provide context-aware information and create awareness to changes in behaviours.

In the same vein, Calvo and Peters (2014) note that technology can have an impact on human potential and wellbeing by fostering positive emotions and allocating 'remembering experiences'; encouraging autonomy, competence and self-actualization; creating self-awareness and self-compassion through metacognition, experimental cognition, affect and behaviour; investing in mindfulness interventions; and, finally, reinforcing empathy, compassion and altruism through storytelling, role-play and communal goals.

In view of all that was mentioned so far, one may suppose that emotional and behavioural design has become of utmost importance for bringing a much more humanistic approach to the Human-Computer Interaction field. The parameters of usability, effectiveness, efficiency and satisfaction are no longer sufficient when the infrastructure, the platforms and software are presented more and more as a service (IaaS, PaaS, and

SaaS) and the design starts to embody such aspects as resilience, happiness, empathy, altruism, wellbeing and quality of life.

4.2 Proxemics in Smart game-playing: The importance of space

Games are a source of Information and Communication that can trigger different cognitive processes (e.g. perception, attention, memory, and decision-making) and in that way have an impact on daily lives, routines, homes and cities. Indeed, the past few years have seen an increasing interest in the emerging of player-citizens from all ages and of different genders and backgrounds (e.g. 'games for a change', 'games with a purpose', '*gamification*', 'alternate reality games', 'location-based games', 'mixed-reality games', 'mobile games').

The man-environment relation is also crucial for designing both behavioural change and active ageing given the fact that the human's habits, needs and desires are often represented within the system (Lang, 1974). Indeed, a 'smart game playing ecosystem' can both strengthen citizen-player driven learning (Costa, Veloso, & Mealha, 2017) and motivate the players to contribute to an ecological, social and economic sustainable environment (Holling, 2001).

Before discussing the use of space in games, it is important to understand what is meant by a 'smart environment.' According to the Timisoara declaration, 'smart environments' are those in which (ASLERD, 2016, p. 3):

> *"individuals that take part in the local processes have a high level of skills and, at the same time, are also strongly motivated and engaged by continuous and adequate challenges, provided that their primary needs are reasonably satisfied."*

In this definition, three game elements can be highlighted and used to introduce the concept of 'smart game-playing' - level of progression and collection of skills; rewarding motivated actions; and involvement of citizens in challenges/missions that can have an impact on society and improve citizens' wellbeing and quality of life. For it, the use of proxemics in game-mediated interactions is crucial in order to encourage the use of shared spaces, artefacts and interaction in both physical and digital (phygital) spaces. It is worth mentioning that the content of this topic and the respective Model of Proxemics in Smart

Game-Playing have been published in the paper "A Review of Proxemics in 'Smart Game-Playing'" (Costa, Veloso, & Mealha, 2017).

Figure 18 shows a model of Proxemics in Game-mediated Interactions. This model is based on Hall's theory (1969) on a "Hidden Dimension" or "Silent Language" that humans use to manage their relational distance, applied in game-mediated interactions.
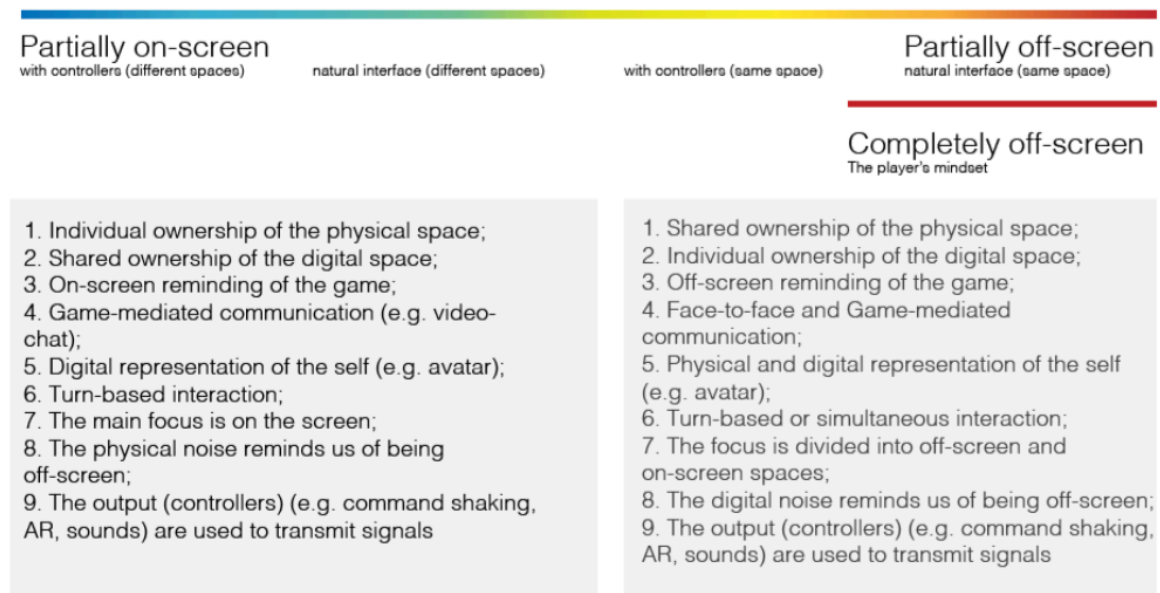
Figure 18. Model of Proxemics in game-mediated interactions (Costa, Veloso, & Mealha, 2017)

Before proceeding to examine the proposed model, it is important to identify the four types of space suggested by Edward Hall (1969): (a) the intimate space; (b) the personal space; (c) the social space; and (d) the public space. These spaces differ in terms of the distance/proximity and sound projection that may affect the interaction between different agents.

Relative to a specific game instance in a pre-determined context, these "proxemics spaces" can be generated with the position of the players and devices, the size of devices, the number of players, types of game and feedback. As game designers should take into account these factors, when designing different types of mediated interactions of phygital places, the model shown in Figure 18 divides these interactions into 'hot mediated interactions' (the ones established in the same physical space – phygital place) and 'cool mediated interactions (the ones established in different physical spaces – non-phygital

places). In terms of the distance/proximity between the players, the model suggests that the distance between players increases (blue and green colour) as the interaction is more mediated. By contrast, players get closer when they share the same space and their interaction is as natural as possible (yellow and red colour).

As the interaction tends to me more mediated, the following characteristics of the space context are likely to occur: Individual ownership of the physical space; Shared ownership of the digital space; On-screen reminding of the game; Game-mediated communication (videochat, instant messaging); Digital representation of the self; Turn-based interaction; The main focus is on the screen; the physical noise reminds us of being off-screen; and The output (controllers) (*e.g.* command shaking, augmented reality, sounds) are used to transmit signals.

When the interactions are partially off-screen, these are likely to be the main characteristics of the interactions: Shared ownership of the physical space; Individual ownership of the digital space; Off-screen reminding of the game; Face-to-face and game-mediated communication; Physical and digital representations of the self; Turn-based or simultaneous interaction; The focus is divided into off-screen and on-screen spaces; the digital noise reminds us of being off-screen; and The output (controllers) (*e.g.* command shaking, AR, sounds) are used to transmit signals.

In summary, proxemics in game-mediated interactions is important in order to create tension between idealized mental representations and the environment. Indeed, depending on citizen-players' interactions with the environment, position and perception towards the environment also tend to change. A 'Smart game-playing' and reciprocal affordances (Gibson, 2015) between what the player can afford from the environment and vice-versa are relevant to encourage citizen-players to (re)act to an ecosystem that is more and more digital and that embodies Information and Communication Technologies.

4.3 Co-designing games for active ageing

Recent developments in the field of Human-computer Interaction have led to a renewed interest in Co-design. To put it simply, if in the late 60s and 70s, much of the development was product-oriented and the interface was quite neglected, nowadays jointly activities that

both involve the end-users and developers have been emerging as process-oriented techniques (Floyd, Mehl, Reisin, Schmidt, & Wolf, 1989; Muller & Kuhn, 1993; Muller, 2003) for fostering inclusivity, user experience, usability and 'look and feel'(Namioka & Schuler, 1993).

In broad terms, 'Co-design' or 'Participatory Design' can be defined as a set of techniques that can be used to actively involve the end-users in the design process (Muller & Kuhn, 1993; Muller, 2003). According to Abras, Maloney- Krichmar, and Preece (2004), co-design is a form of user-centred design that involves users as partners in the design process by fostering communication, teamwork, freedom to explore new ideas and thus providing new insights, different perspectives, and knowledge (Sears & Jacko, 2007). In general, these techniques follow the philosophy "for, with and by the users" (Parra, Andrea, & Giacomin, 2012).

In an analysis of different types of user participation in design, Lee (2008) has found that three modes of participation can occur: (a) Public Participation (designers and experts make attempts to assess users' cognitive models with partial user involvement); (b) Design Participation (designers and users are both equally involved in the design process); and (c) Community Participation (users are totally engaged in the design process and designers are only advisers without much interfering). Depending on the level of involvement of the end-users in the design process, such co-design techniques as BrainDraw and Group Elicitation Method (GEM); Lunchbox project; PICTIVE/TelePictive; Strategic visioning and future workshops; Card Sorting; Low-tech prototypes; Drama, storyboarding and organizational games; Collaborative Analysis of Requirements and Design (CARD) and Contextual Inquiry can be used. In the sections that follow, these different techniques are discussed and a framework proposal to co-design games for active ageing, healthy lifestyles and changes in behaviour is proposed.

4.3.1 Co-design techniques

As Sanders (1999; 2002) remind us, Co-design techniques should assess users' sensation, knowledge, rememberability and expression. For example, these techniques can be used for: (a) thinking (e.g. collage and brainstorming); (b) mapping and visioning (e.g. low-tech prototypes, mock-ups); (c) understanding feelings (e.g. ethnographic, cooperative evaluation); and (d) storytelling and dreaming (e.g. strategic visioning, scenario building,

games, stories and drama). Given its importance, this subsection presents an overview of a set of techniques that can be followed in order to involve the end-users in the design process: BrainDraw and Group Elicitation Method (GEM) (Almeida, Almeida, Miranda, Hayashi, & Baranauskas, 2009; Boy, 1997; Walsh, 2010), Lunchbox project (Namioka & Schuler, 1993), PICTIVE/TelePictive (Miller, Smith, & Muller, 1992; Namioka & Schuler, 1993), Strategic visioning and future workshops (Sanders, 1999), Card sorting (Tudor, Muller, Dayton, & Root, 1993), Low-tech prototypes, drama, storyboarding and organizational games (Bowers & Pycock, 1994; Madsen & Aiken, 1993), Collaborative Analysis of Requirements (CARD) and Design and Contextual inquiry (Muller, Wildman, & White, 1993).

A. *BrainDraw and Group Elicitation Method (GEM)*

BrainDraw and Group Elicitation Method are both techniques that aim to foster brainstorming, shared language and shared memories (Almeida et al., 2009).

BrainDraw is a turn-based technique in which each participant initially draws a concept in a piece of paper that is circulated and completed by other participants' sketches (Almeida et al., 2009). In the end, the whole ideas contained in this paper are discussed within the team and consensus reached on final solutions.

In the Group Elicitation Method (GEM), the participants are given a piece of paper on which ideas/concepts are written and similarly to the BrainDraw technique, this paper is circulated to other participants. This process is divided into the 6 phases (Boy, 1997, p. 28):

1) Formulation of issue statements and selection of participants;

2) Generation of viewpoints that are circulated between participants;

3) Reformulation of viewpoints into more elaborate concepts;

4) Generation of relationships between these concepts;

5) Derivation of a consensus; and

6) Critical analysis of the results.

B. Lunchbox project

The Lunchbox project is based on the users' drawings and collages to understand ideas about what would lunchboxes look like. Although this type of project tends to be directed towards children, drawing materials and collage with words and images are important techniques in a co-design project.

C. PICTIVE, TelePictive

Plastic Interface for Collaborative Exploration Technology Through Video (PICTIVE) is a technique that makes use of such everyday materials as pieces of paper or plastic, post-its, pop-up-events, labels, coloured pens and highlighters, pencils, scissors among others (Namioka & Schuler, 1993) or software-assisted – TelePICTIVE (Miller et al., 1992; Namioka & Schuler, 1993).

In this technique, participants are previously informed about the need and mission of the project or product and then they create the design of the interface, manipulate the objects and justify their design options. These sessions are often video recoded.

The main advantage of PICTIVE is in avoiding the need for specialized knowledge of users (Namioka & Schuler, 1993) and having a graphical and textual-based solution for a problem through rapid prototyping (Muller et al., 1993). In addition, iconic design games, in which participants are given sets of concepts and draw pictures or review the sketches, can also be used (Namioka & Schuler, 1993).

D. Strategic visioning and future workshops

Strategic visioning and future workshops are tools that aim to facilitate people's expression of their own ideas and dreams, through collaboration activities, visual cues or discussions (Sanders, 1999).

According to Namioka and Schuller (1993), this technique is divided into the following phases:

1. Critique in which several themes and learning practices are introduced and discussed;

2. Role-play fantasy in which participants had the freedom to explore new ideas and concepts through brainstorming techniques and categorization of the main ideas into headings and themes; and

3. During the implementation, the raised ideas are converted into goals and adjusted to the existing resources and time.

E. Card sorting

Card Sorting is a co-design technique used with the purpose of encouraging the end users to organize information and concepts (Cooper, Reimann, & Cronin, 2007). For example, the end-users are asked to sort a deck of pictures, cards or objects that can be either physical or virtual and match them to a certain type of information or functionality of the product that is being designed (Cooper et al., 2007; Hudson, 2013). This is generally conducted in groups and rely on the participants' organizational skills. That way, designers can check the terminology used, determine the type of relationships that can exist between concepts (e.g. proximity, similarity) or the categories that the concepts belong to (Hudson, 2013).

F. Low-tech prototypes

A more 'design-by-doing approach' (Bødker, Grønbæk, & Kyng, 1993) is followed when using mock-ups and low-tech prototypes. Indeed, low-tech prototypes can be essential in co-design as they demonstrate the main functionalities and the conceptual model of a project. This technique can encompass the following elements (Bødker et al., 1993):

- Low-tech objects: These objects often derive from the users' daily routines and tend to be non-computer representations.

- Paper prototyping, flowcharts and mock-up: Different forms of representation of information can also be used in order to facilitate the communication between designers and end-users. Whereas in paper-prototyping, paper sketch and usability

evaluations are used to make design decisions, flowcharts focus on the flow of the information and sequence of the events that occur and the mock-ups use paper illustrations and screenshots (Resatsch, 2010). The Wizard of Oz prototyping can be also used when the interaction with the interface depends on the responses given by the end-user (Arnowitz, Arent, & Berger, 2010) or video prototyping that uses video in order to test and sell the vision of a certain product and help with the decision-making process (Arnowitz et al., 2010).

- Scenario-building diagrams: These diagrams present the different uses of an interface or device and thus, encourage the stakeholders to enact possible scenarios.

In general, low-tech prototypes are good for testing and redesigning the product (Wood, 1997) and they are often used because of their easiness, rapid availability and low costs (Gengnagel, Nagy, & Stark, 2015).

G. Drama, storyboarding and organizational games

The user can also be involved in the design process through the use of dramas, storyboard and organizational games.

In dramas, the end-users are invited to be the protagonists of a role and can change it until they are satisfied with the result. During the process, the end users express their actions, thinking and motivations (Brandt & Grunnet, 2000).

Considering that stories have the potential to foster conversation and get the feedback towards the way the product will be used (Salvador & Howells, 1998), storyboarding can be performed as a summary of these jointly story-based interactions between the designers and the end users (Muller, 2003).

Finally, organizational games can be divided into the following steps: 1) Start with a prologue; and 2) Playground in which the end-users negotiate different actions to different scenarios that are presented in situation cards (Namioka & Schuler, 1993).

H. Collaborative Analysis of Requirements and Design (CARD)

The Collaborative Analysis of Requirements and Design (CARD) is a technique that rely on the use of cardboards in order to analyse the different functions and characteristics of a product based on the information obtained from the participants, which can include

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(Muller, 2001; Tudor et al., 1993): end-users' activities; interface events; social events; cognitive, motivational and affective events.

I. Contextual inquiry

The contextual inquiry is frequently used in the areas of psychology and sociology. This technique aims to assess current practices and experiences from the end users when interacting with the designed artefacts in their workplaces (Holtzblatt, Wendell, & Wood, 2004; Namioka & Schuler, 1993).

This technique tends to be performed one-to-one and complemented with observations. Indeed, the process is guided by three main principles: (a) the context; (b) the dialogue between the designer and user (partnership and interpretation); and (c) the focus of the study (Holtzblatt et al., 2004; Namioka & Schuler, 1993). The contextual inquiry can be performed through the use of surveys in order to assess the users' preferences and motivations; operability assessment whether a simulated interface is being tested; focus groups in order to brainstorming product ideas; field visits and observations aiming at collecting information about the context of the users (*e.g.* photographs or cultural probes) and interviews or group discussions (Namioka & Schuler, 1993).

Taken together, these techniques highlight the importance of the end-user's involvement in the design process and were the basis to propose a framework for involving the end-users in the game design for active ageing and healthy lifestyles.

4.3.2 Co-design process of a game-living system: A framework proposal

Lack of involvement of the end users in the game design process has existed for many years. Indeed, in the specific case of games, game design has only been tested during the playtesting and post-production phases instead of involving the users in the early design stages of the game development cycle (Costa, 2013; Costa & Veloso, 2016b; Veloso & Costa, 2015).

Although there are a number of publications about the use of co-designing techniques with older adults (Botero & Hyysalo, 2013; Davidson & Jensen, 2013; Xie, Druin, et al., 2012; Xie, Yeh, Walsh, Watkins, & Huang, 2012), few publications (Rice, Cheong, Ng,

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Chua, & Theng, 2012; Veloso & Costa, 2015) have covered the use of co-designing techniques in games that address the theme of active ageing.

Given that the use of co-design in games has been understudied, a framework was proposed based on both the review of different co-design techniques and the researcher's experience in the field. The following theoretical framework proposal (Figure 19) has been published in the article *Co-designing a game-based learning platform for active ageing: The case of JUMP* and was essential to carry out the empirical study.[13]

Figure 19. Co-designing process of the game living system for active ageing (Framework proposal)

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[13] Although the reader could expect this section to come under the Method section, the author decided to present it in the Theoretical Framework section as this proposal has been already published and serves as basis for the methods used.

As shown in Figure 19, different stakeholders and Co-Design techniques can be used in different phases of the development cycle of a game. This process fall under three main phases: 1. Co-designing tools used for the Game Embryo; 2. The Lab Microscope; and 3. Verifying the game DNA.

In Co-design tools used for the Game Embryo, the process of ideation occurs, the experts in different domains validate the learning content and the players are strongly involved in the process, in order to meet their context and motivations. This phase embodies such Co-design strategies as: Strategic visioning and future workshops, Scenario building, and Contextual inquiry.

In The Lab Microscope, personas are used based on the previous experience during the 'Game Embryo'. The users are not directly involved and the team's creative authorship is stimulated. Nevertheless, the contributes from the game team take into account both the end-users' context, values and requirements and the established learning goals articulated with the group of experts.

Finally, verifying the game DNA embodies the presentation and test of the game prototype with a large number of participants, representative of the target group. The participants are asked to reflect on the product design, encourage to criticize it and discuss the way the game can encourage active ageing, using cooperative evaluation as technique (Dix, Finlay, Abowd, & Beale, 2004).

In the specific case of this study, a set of co-designing tools were necessary to design the domains: (AC) Active ageing, lifestyles and changes in behaviour; (GT) Game techniques and game elements; and (L) Learning.

In '(AC) Active ageing, healthy lifestyles and changes in behaviour', the following techniques are suggested: contextual inquiry, expert review and strategic visioning and future workshops.

For example, the use of contextual inquiry as technique can be used with the purpose of assessing the participants' current practices, motivations and experiences associated to active ageing and changes in behaviour. Although this technique tends to be one-to-one (Holtzblatt, Wendell, & Wood, 2004; Namioka & Schuler, 1993), group discussions can be also complemented with observation.

Expert review is often used to review the learning goals and content of a product. That said, in this study, expert review can be applied to the different domains of Active Ageing (Health, Security and Society) and threfore, assess the quality of the learning goals, the content covered and relevancy to Active Ageing, the risk of multiple interpretations or ambiguity in the use of terms, the language used, among other criteria.

In terms of strategic visioning and future workshops, this technique would be transversal to all domains (AC, GT and L), during the game embryo phase. Indeed, this technique can be used to find the end users' concept of active ageing, preferred activities, and skills to practice.

In '(GT) Game techniques and game elements', scenario-building, contextual inquiry, strategic visioning and future workshops can be also used. For example, scenario-building can help to understand how the end-users solve problems whereas observation and contextual inquiry can be used to understand their interaction patterns. Both techniques can be also valuable to understand the main requirements relative to the narrative form, the use of game resources and game elements.

Finally, in 'Learning', contextual inquiry and expert reviews are suggested to be suitable to understand the end users' motivation for learning, define the learning goals and understand the learning context/preferences.

Beyond this framework, the following principles proposed in the literature were taken into account: (a) Getting participants to know terminology; (b) Plan the co-design process in terms of the aspects of form (aesthetic design) and function (technical design); (c) Use stories, surveys and 'show and tell' workshops; (d) Create personas; (e) Give time to team-based activities and use sticky notes to share ideas; (f) Provide food/gifts to appreciate the participation of the subjects; (g) Enable informal conversations between the participants; (h) meet the ethical challenges associated to the codesign process; (i) adapt the co-designing techniques to the participants' abilities and limitations; (j) enable participants' self-reflection, negotiation and creation of games.

4 DESIGNING FOR BEHAVIOURAL CHANGE AND ACTIVE AGEING

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Comments on the literature review

The definition of active ageing has been evolving over time and been subjected to some criticism. If, in the beginning, much focus has been given to the functional status and absence of illness, in today's society it also embodies a multitude of effects of the ageing process (e.g. biological, psychological, societal) and the notion of wellbeing and quality of life.

According to the World Health Organization (2002, p.12), "*Active ageing is the process of optimizing opportunities for health, participation and security in order to enhance the older adults' quality of life as people age.*" Although the concepts of health, participation and security are highlighted and defined in the WHO report, the majority of studies that address this topic do not seem to take into account these three variables in detail. Indeed, few studies in the development of products or services for active ageing assess their effectiveness on the participants' wellbeing and quality of life (as this is the main purpose of active ageing).

The concerns about wellbeing and quality of life have been debated over centuries, however, only recently there has been a growing interest in studying the role of emotions and behaviours for developing technologies that have an impact on the end-users' wellbeing and quality of life. In addition, the challenges of ageing posed to the Information

and Communication Society have led to the emergence of a new scientific subject entitled Gerontechnology that can address the following domains: Anti-ageing Technologies; Assistive/Adaptative ageing Technologies; and Enhanced/Ameliorated ageing Technologies. Alongside these domains, the development of inclusive and literate environments has become a central issue for closing the gap between generations, yet technological determinism and the problems of ageism, techno-ageism and game-ageism should not be overlooked.

There are a number of recommendations for developing meaningful learning environments for active ageing based on the Political Declaration and Madrid International Plan of Action on Ageing (UN, 2002a), the Hamburg Declaration on Adult Learning (UNESCO, 1997) and the Andragogical principles presented by Knowles, Holton and Swanson (2005). For example, designers of such environments should foster goal-oriented learning programmes; create collaborative and safe learning environments (taking into account the learners' pace and confidentiality); match the knowledge transmitted to the learners' life experiences; and motivate the adult learners to produce their own learning artefacts and share them with younger generations. Nonetheless, it should be noted that the learning process is not homogeneous.

Games may also have a potential to learn and adhere to certain behaviours as they can function as a call to solve daily-life problems by transferring some of the game techniques to trigger intrinsic motivations and, thus, learn and improve behaviour-related outcomes (see, for example, in Figure 17 how it can be applied).

Finally, there are are a number of implications for designing learning environments with impact on health-behaviour change and that way bring a much more humanistic approach to the Human-Computer Interaction field. For that, proxemics (i.e. the way we interact with phygital spaces) and the initial involvement of the end-users in the design process through codesign techniques are fundamental to meet and antecipate the end-users' needs and motivations as well as strengthen the connection among the system, the end-user and the surrounding environment.

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5 Empirical Study[14]

«Play is the highest form of research»

– Einstein (as cited in Hojjat, Fukuzaki, &
Sowa, 2016, p. 43)

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[14] Part of the content of this Chapter has been published in the following papers:

Costa, L. V., Loizou, M., Arnab, S., & Veloso, A. I. (2017). *Games for Active Ageing, Wellbeing and Quality of Life: A Pilot Study*. In press

Costa, L. V., Loizou, M., Arnab, S., & Veloso, A. I. (2017). *Breaking barriers to game-based learning for active ageing and healthy lifestyles: A qualitative interview with experts on the field*. In press

Costa, L. V., & Veloso, A. I. (2017). Co-Designing a Game Based Learning Platform for Active Ageing: The Case of "Jump." In *GAME-ON'2017, 18th Annual Conference on Simulation and AI in Computer Games*.

Costa, L. V., & Veloso, A. I. (2016). "'Game-based psychotherapy' for active ageing: A game design proposal in non-game context". In *Proceedings of the TISHW 2016 - 1st International Conference on Technology and Innovation in Sports, Health and Wellbeing, Vila Real, 1-3 Dec. 2016*, USA: IEE 2016, 1-8. https://doi.org/10.1109/TISHW.2016.7847788

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5 Empirical Study

The purpose of this research is to assess the effectiveness of Game-based Learning to encourage active ageing, in comparison with a Computer-Assisted Learning Platform (online video-based course).

5.1 A mixed-method approach

Given the research question *"In what way can Game-based Learning affect active ageing?",* it was required to develop a methodological framework that could identify the main design components that a Game-based Learning Programme should have in order to be effective for affecting active ageing.

For this reason, a group of adult learners aged 50 and over (co-design group - G0) was involved in the design of two comparable learning programmes (Game-based Learning and a Computer-Assisted Platform), whereas other groups of the same age (Experimental group - G1 and Comparison Group- G2) tested those digitally-mediated programmes and were assessed on their perceived health-related wellbeing and quality of life, using the SF36-v2 and WHOQOL-BREF scales before, during and after each experiment.

A mixed-method approach was used in this study owing to the fact that the solely use of a quantitative or qualitative approach would be insufficient to provide better understanding of the research problem and the research question (Cohen, Manion, & Morrison, 2013). The origins of mixed-methods procedures date back to the late 1950s with the multitrait - multimethod matrix to study psychological traits developed by Campbell and Fiske (1959), however the practice of combining both quantitative and qualitative approaches to address a research problem is very recent. In addition, there has been an increasing use of this

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research method and a number of publications (Fang, Lin, & Chuang, 2009; Law & Sun, 2012) have also applied this approach to the areas of education and game studies.

In this study, an exploratory sequential mixed-method approach (QUAL -> quant -> qual) was used (as mentioned in the Introduction – Research question and hypotheses, p.4). As an exploratory study, the research began with a qualitative phase- i.e. Co-design sessions with adult learners aged 50 and over (G0) in order to assess and analyse the main requirements to develop both the Game-based Learning and Computer-Assisted Learning programmes and, thus, understand the main design components that a digitally-mediated programme should have for affecting active ageing [PHASE 1 – The Participatory Action Qualitative Research].

Then, the quantitative phase consisted of an experimental study, involving two groups (G1 and G2) of adult learners aged 50 and over in the test of the learning programmes co-designed previously with G0. The Experimental Group (G1) tested firstly a Game-Based Learning Programme (GBLP) and then a Computer-Assisted Learning Programme (CALP) whereas the Comparison Group (G2) tested firstly the CALP and then the GBLP. A Control Group (G3) that did not take part in the intervention was also involved. These experiments had the purpose of testing whether there were significant differences between the type of experiment undertaken and the perceived health-related wellbeing and quality of life [PHASE 2 – The Quantitative Experimental Research].

Based on the results obtained from both phases [PHASE 1 and PHASE 2], prototype testing with G1 and G2 and set of interviews were conducted with experts in the fields of games, psychology and ageing studies in order to further understand the way the design components of the learning programmes mentioned by the adult learners (G0) helped to explain the influence of Game-based Learning on the adult learners' wellbeing and quality of life [PHASE 3: Mixed-method Research]. Figure 20 illustrates the different steps that were undertaken in this sequential mixed-method approach.

The rationale for using the mixed-method as a research design were:

- Develop better learning programmes addressed to the adult learners aged 50 and over by involving them in the process, collecting and analysing the qualitative data in order to assess its effectiveness to affect active ageing;
- Refine the learning programmes to serve as an instrument to an experimental study to assess their effectiveness to affect active ageing;

- Cross the data obtained from the quantitative approach with the data obtained from the qualitative phase to assess the participants' context, the strengths and weaknesses of both platforms, self-perceptions of wellbeing and quality of life and the way the challenges observed could be met by the game industry and market.
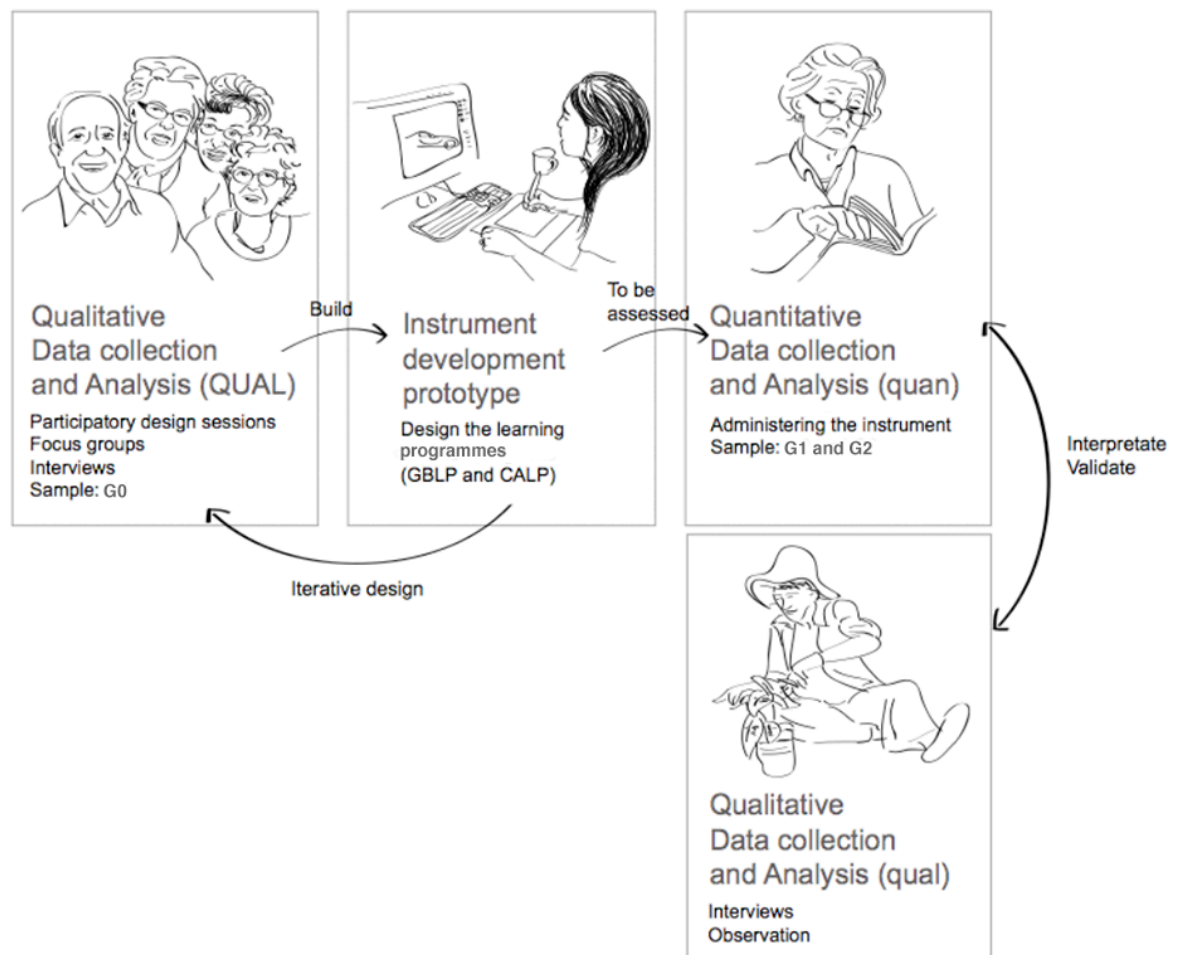
Figure 20. Visual model of the exploratory sequential mixed-method approach

In a nutshell, the quantitative approach enables to overpass the limitations of the qualitative one and vice versa. In fact, the mixed-method approach follows a pragmatic worldview by focusing on the research problem and the application of the knowledge in practical issues and consequences (Hookway, 2013).

The concept of pragmatism has been characterized by some scepticism towards the use of one specific type of research (quantitative vs qualitative) and area (science vs morality and religion) to seek the truth and the meaning of a phenomenon and thus, the pragmatic

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philosophical worldview seems to be the most suitable to meet the challenges of a multidisciplinary area of research − borrowing concepts from the Information and Communication Sciences, Cognitive Psychology, Game Studies, Education Sciences and Gerontology. The following is a brief report on both the quantitative and qualitative approaches.

5.1.1 Overview of the mixed-method approach

The present mixed-method research was divided into the following PHASES (Table 08):

- *PHASE 0_Design research:* In this Phase, the literature was reviewed and the materials needed to carry out the co-design sessions were planned and assessed by a group of experts in the fields of Gerontology, Psychology; Education and Social Work. The instruments used for data collection were the scientific databases and surveys to assess the quality of the learning content and procedures to be undertaken.

- *PHASE 1_The Participatory Action Qualitative Research*: In this Phase, 33 adult learners (G0) at a University of Third Age were involved in the co-design sessions (from March 2015 to December 2016, 2-hour session per week) and developed both learning platforms. The instruments used for data collection were the field notes and co- design techniques.

- *PHASE 2_The Quantitative Experimental Research*: In this Phase, a total of 60 adult learners at 4 Universities of Third Age (including 12 learners of G0)[15] were divided into: Experimental Group (tested firstly the GBLP, then the CALP), Comparison Group (tested firstly the CALP, then the GBLP) and the Control Group (without intervention). Before, during and after each experiment, the WHOQOL-BREF and the SF36v2 scales were administered.

- *PHASE 3_The Mixed-method Research*: In this Phase, the information obtained in the previous phases (PHASE 0, PHASE 1, and PHASE 2) was compiled and

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[15] Although 12 adult learners of G0 were involved in the PHASE 2: The Quantitative Experimental Ressearch, there is not a group bias affecting the results as this group (G0) did not have pre-access to the final product (partial involvement)

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crossed with the data obtained from group discussions with G1 and G2 about the pros and cons of each experiment and a set of recommendations provided by a group of experts in the domains of Games, Human-Computer Interaction, Psychology and/or Ageing Studies. The instruments used for data collection were Field notes, Group discussions and an Interview guide/protocol.

Table 08. Schedule of the activities carried out in the mixed-method research

Stages	Date	Activities/Description	Method	Data collection
PHASE 0: Design research	June 2014 to March 2015	Review the literature; Plan the co-design techniques	Literature review	Databases; Surveys to assess the quality of the content and procedures
PHASE 1: The Participatory Action Qualitative Research	(A) March 2015 to December 2016; (B) December 2015 to February 2017	(A) Involve a group of 33 adult learners (G0) at a University of Third Age in the co-design sessions [March 2015 – December 2016, 2-hour session per week]; (B) Develop both learning platforms [December 2015 to February 2017].	Participatory action research (QUAL)	Field notes; Co-design techniques
PHASE 2: The Quantitative Experimental Research	March 2017 to June 2017	Divide a total of 60 adult learners (G1, G2 and G3) at 4 Universities of Third Age [including 12 learners of G0] into: Experimental group (test firstly the GBLP, then the CALP), Comparison group (test firstly the CALP, then the GBLP) and the Control group (without intervention); Administer before, during and after each experiment (3 out of 6 weekly sessions), the WHOQOL-BREF and SF36v2; Provide a set of recommendations to develop a game-based learning strategy for active ageing.	Experimental research (QUAN)	Scales (WHOQOL-BREF, SF36v2 with permission given)
PHASE 3: The Mixed-method Research	May 2017 to October 2017	Group discussions with G1 and G2 relative to the pros and cons of each experiment; Interview a group of experts in order to propose a set of recommendations based on the participants' context and current trends or solutions in the game market.	Group discussions (G1 and G2) Interview (QUAL)	Field notes and group discussions Interview guide/protocol

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In the sections that follow, each PHASE will be described in detail in terms of the activities carried out, the method and the instruments used for data collection.

5.1.2 PHASE 0: Design research

In this Phase, topics related with Health, Security, Participation in Society, Learning and Co-Design were reviewed. After reviewing these concepts, a set of sessions relative to the aforementioned concepts were planned and divided into the following modules:

1. Presentation of the Research Project;
2. Physical activity;
3. Nutrition;
4. Cognitive activity;
5. Sense of Security; and
6. Participation in Society

The activities for each session are illustrated in Table 09. The purpose of these sessions was twofold: (a) understand the participants' context and their perception towards ageing (health, sense of security and participation in society); and (b) brainstorm the functionalities of a game-based learning programme for active ageing [PHASE 1 – The Participatory Action Qualitative Research].

The materials and surveys were validated by a group of four experts in the fields of Gerontology, Psychology, Education and Social Work and these were the criteria relative with the content covered: (a) The goals presented were (not) specific, measurable, achievable, realistic and time-based; (b) The content covered/did not cover essential topics related with the concept of Active Ageing; (c) The module content was (not) sufficient and clear; (d) There was (not) a risk of multiple interpretations or ambiguity in the use of terms; (e) The sequence in which the content presented was (not) the most appropriate; (f) There were (not) terms that needed explanation; (g) The subject was (not) in-depth in view of the objectives presented; (h) The language used was (not) clear and accessible; (i) The content was (not) updated; (j) The literature presented was (not) relevant to support the arguments presented.

As for the survey, the criteria were: (a) The scope and the purpose of the research was (not) explained; (b) The instructions were (not) sufficiently and clearly described; (c) There was (not) risk of multiple interpretations or ambiguity in the use of terms; (d) The

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sequence of the questions; (e) Suitability of the questions to each section; (f) Number of repeated or inappropriate questions; (g) Terms that needed explanation; (h) Adequacy of the scale used; (i) Suitability of the questions formulated for the analysis; and (j) Validity of the content in scientific terms.

Table 09. Activities carried out during the co-design sessions

Session number	Activities
Session 1	*Presentation of the Research Project* Introduce the researcher, the research project, procedures, the rationale for doing research, the main goals, the topics to be drawn during the course, and the chronogram of the learning sessions.
Session 2	*Debate on physical exercise for active ageing* Discuss the role of leisure and physical exercise in encouraging active ageing; Build a learning programme that encourages physical activity.
Session 3	*Debate on nutrition for active ageing* Describe the factors that influence nutrition and the consequences of malnutrition; Identify the nutrients that exist in different foods and diets; Build a learning programme that encourages healthy diets.
Session 4	*Debate on cognitive activity* Discuss the role of leisure and cognitive activity in encouraging active ageing; Build a learning programme that encourages cognitive activity.
Session 5	*Debate on the sense of security* Describe the rights associated to human and environmental security; Apply the strategies of security and prevention in different contexts; Build a learning programme that encourages the sense of security.
Session 6	*Debate on the participation in society* Identify some projects related with participation in society through the use of Information and Communication Technologies; Build a learning programme that encourages the participation in society.
Session 7	*Debate on the process of learning* Look at the different factors of the learning process; Discuss different elements of the learning programme.
Session 8	*Interaction with Information and Communication Technologies* Identify the learners' needs and motivations to use and learn Information and Communication Technologies; Identify the main barriers and pros in the use of different interfaces adopted in Information and Communication Services.

These planned sessions were crucial to carry out the co-design sessions described in PHASE 1 – The Participatory Action Qualitative Research.

5.1.3 PHASE 1: The Participatory Action Research (Qualitative Phase)

According to Denzin and Lincoln in *Handbook of Qualitative Research* (2000, as cited in Silverman, 2013), qualitative research attempts to understand the meaning of social experiences by presenting the following basic characteristics (Tracy, 2012): (a) taking a holistic view of the research phenomenon; (b) providing multiple perspectives and being flexible to attribute the meaning to multiple sources of information; and (c) being attentive to the context and the participants' perspective. Given the aim of the qualitative research and its main characteristics, the qualitative approach was used to understand the design components that a learning programme should have in order to be effective for affecting active ageing.

A Participatory Action Research (PAR) was carried out and data was collected from March 2015 to December 2016 (2-hour session per week). According to McIntyre (2008), this type of research demands commitment to understanding a certain problem and engagement in the search for a solution that is beneficial to society. In addition, the same author (2008) points out that the subjects of the research are strongly involved in a cyclical study, building alliances with the researcher. Hence, a group of participants (Group 0 – G0 was involved in the design process of the Game-Based (GBLP) and the Computer-Assisted Learning Programme (CALP) Programmes by generating ideas through the use of co-design techniques.

A. Setting and data collection

This study was carried out in the participants' natural context (University of Third Age) and included participant observation, group interviews and questionnaires about their perception of physical exercise, nutrition, cognitive activity, human security, participation in society and learning preferences. The participants were given a 2-hour session per week and a total of 29 classes that included both the sessions presented in Table 08 and extra classes relative to the use of Information and Communication Technologies (ICT). These latter classes aimed at, on the one hand, gaining the participants' confidence, commitment and trust and, on the other hand, assessing the participants' learning context, motivations, interaction patterns and difficulties when using ICT.

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In terms of the participant observation, an observation protocol was used for recording the design sessions. This protocol was structured as follows: reference number, place, date and time, activity and goals, portraits/description of the main actions with the participants' statements, and references to audio-visual materials/photos/documents.

Group discussions were also used with semi-structured open-ended questions. The structure of these group interviews had the following goals: (a) generating new ideas for the learning programmes (GBLP and CALP); (b) validating the relevancy of the learning elements; and (c) providing insights into the design issues of the prototype (see *Strategic Visioning and Future Prototypes*, Chapter 4 Designing for behavioural change and active ageing). The interview protocol begins with a welcome message and ice-breaker questions, then the questions regarding the learning process, the game-based and the computer-assisted learning programme were followed, ending with an acknowledgment. These discussions were fostered using cardboards (Figure 21).

Figure 21. Materials used during the group discussions

In terms of the co-design technique used, a 'Strategic Visioning and Future Workshops' was performed in order to understand the learning context and facilitate the adult learners' expression of their ideas and dreams, trough collaboration activities, visual cues or discussions. This technique followed the phases: 1. Critique in which several themes and learning practices were introduced and discussed; 2. Role-play fantasy in which

participants had the freedom to explore new ideas and concepts through brainstorming techniques and categorization of the main ideas into headings and themes; and 3. During the implementation, the raised ideas were converted into goals and adjusted to the existing resources and time.

The questionnaires were used, aiming at assessing the participants' context (Co-design group – G0) and their motivations to learn and adhere to cognitive activity/learning, their perceived concept of active ageing, physical exercise, nutritional status and context, sense of security and participation in society.

The participants' initial assessment towards cognitive activity/learning

The participants of the co-design sessions (G0) were surveyed about their main motivations to adhere to a learning programme and learning preferences.

To answer the question *"What motivates you to adhere to a learning programme?",* the participants were given a list of reasons why they might adhere to the programme or indicate other reasons in the "Other" option. The items included *'Pleasure and fun', 'Relax', 'Pass time', 'Meet new people and make friendships', 'Improve self-esteem'. 'Improve cognitive capacity', 'Increment participation in activities', 'Update skills at work', 'Foster life-long learning', 'Encourage intergenerational learning', 'Personal fulfilment'* and *'Prevent or lessen the severity of certain diseases –e.g. Alzheimer, dementia...).'* The participants could also choose more than one answer.

The options provided in this survey are in accordance to the adult learning recommendations mentioned in Chapter 2 Meaningful Learning Environments for Active Ageing (p. 65), in which the designers of the learning spaces and learning practitioners should: Create collaborative and safe learning environments *('Meet new people and make friends', 'Increment participation in activities'*); Adapt adult learning to the changing world of work (*'Update skills at work', 'Foster life-long learning'*); Meet the learners' self-concept and take into account the learners' pace and confidentiality (*'Improve self-esteem' 'Pleasure and fun', 'Relax', 'Pass time', 'Personal fulfilment'*); Foster self-direct learning and take into account the ageing factors (*'Prevent or lessen the severity of certain diseases'*); and Motivate adult learners to produce their own learning artefacts and share them with younger generations (*'Encourage intergenerational learning'*). In addition, the

participants were also asked whether they had enrolled in an online course yet and what drove them to enrol in those courses.

Considering that the learning process is not only biological but also sociocultural, the participants were given a number of sentences to rate from 1 (1= totally disagree) to 5 (5= totally agree) their learning preferences. These sentences were categorized into the following theories: Behaviourism (BH), Cognitivism (CG) and Constructivism (CT) introduced in Chapter 2. Meaningful learning environments (2.1. Learning theories) (p. 67).

Based on the Behaviourism, the following statements were formulated:

1. "*My surroundings affect my learning process (e.g. place, people…)*": This statement refers to the fact that learners' behaviours can be shaped by different environmental *stimulus* and positive or negative reinforcements (i.e. rewards or punishment);

2. "*New apprenticeships influence my behaviours*": This statement is relative to the perceived interrelationship between the learning process and behaviours, as shown in Behaviourism (Chapter 2);

3. "*I like that the goals of the training activities, which I participate, are presented*": This statement refers to the design of goal-oriented learning programmes (GOMS – Goals, Operators, Methods, Selection, Rules model); and

4. "*I learn a lot through observation of others' behaviours, attitudes and herein consequences*": This statement refers to the process of observational learning (by observing others' behaviours, attitudes and herein consequences) (Social Learning Theory).

In terms of Cognitivism, the following statements were formulated:

5. "*I like when schemas are presented relative to the learning content*";

6. "*I learn better if words and images are displayed rather than only images*";

7. "*Learning is a discovery process*";

These statements (5, 6, 7) refer to the view that the learner is seen as an information processor and learning is based on mental constructions of daily life events and symbols, as stated in Cognitivism. The statement 6 alludes to the Cognitive Theory of Multimedia Learning, in which words and pictures can be more 'processed' than just words.

8. *"Emotions have a strong influence on my learning process"*;

9. *"My success in training activities depends on my effort"*;

10. *"My success in training activities depends on the difficulty level of the task"*;

11. *"My success in training depends on the luck factor"*;

The statement 8 highlights the importance of emotions to the learning process whereas the statements 9, 10 and 11 refer to the factors that can influence the learning success: effort, task, difficulty level and luck (Attribution theory).

12. *"I often select only the information that interests me"*;

13. *"I like to start with simple challenges and then move to the difficult ones"*;

14. *"I like examples to be presented about what I am learning"*.

The statements 12 and 13 are relative to the cognitive theory of multimedia learning. In other words, the learning process is dependent on the process of filtering, selecting, organising and manipulating information. The statement 14 alludes to the situated cognition principle (interconnection between the learning content and the individuals' daily life).

Finally, the following statements were formulated based on the Constructivism theory:

15. *"I like to participate in group activities;"*

16. *"I like to build my own knowledge"*;

17. *"I enjoy sharing information with people who have common interests"*;

18. *"I enjoy learning challenges"*;

19. *"I enjoy learning challenges that meet my learning capacities"*.

In these statements (15, 16, 17, 18, and 19), learners are seen as active constructors of their klnowledge and the learning process is driven by the problems and challenges posed. As learning is seen as a self-discovery process (Cooper, 1993; Schunk, 1996), the social component (statements 17, 20, and 21) are also relevant. Indeed, social interactions and the communities of practices that can be illustrated in the statements 20 and 21 are fundamental to facilitate the process of constructing knowledge.

20. *"I like to use Information and Communication Technologies (ICT) to learn and share information"*

21. "I enjoy sharing knowledge with people with the same interests as me"

In these two latter statements (20 and 21), the Connectivism theory is also present in the way that knowledge can be distributed in a network and communities of practice can be formed.

The participants' perceived concept of active ageing

During the group discussions, the participants were also asked about their own concept of active ageing in order to understand whether the participants' view on the concept was in accordance with the definition and the different domains provided by the World Health Organization (2002) (Chapter 1."Active ageing", p.23).

The participants' initial assessment towards Physical Exercise

In terms of Physical Exercise, the participants were asked whether they practised any physical exercise and to highlight the main reasons for practising or not practising Physical Exercise. Another aspect that was addressed was the place chosen to do exercise and the main functionalities that participants would like to have in a learning programme related to Physical Exercise.

For the purpose of assessing the participants' attitudes towards Physical Exercise, a set of statements was given to them in order to rate from 1 to 5 their level of (dis) agreement (1=Totally disagree; 5= Totally agree).

The formulated statements were based on the potential benefits for practising Physical Exercise, mentioned in Chapter 1. "Active Ageing" (Santos & Knijnik, 2009, p. 25; World Health Organization, 1996):

- *'Doing exercise with people of the same age is good for socializing'*;
- *'Doing exercise in a balanced way is essential to good health'*;
- *'Doing exercise helps me to relieve anxiety and cope with emotions';*
- *'Doing physical exercise in groups is more fun than individual exercises';* and
- *'Physical exercise is important to general health.'*

Finally, the participants were shown examples of the use of Technology in Physical Exercise and based on these examples and a discussion about the role of technologies in

Health, they were asked about the main functionalities that they would like to have in a learning programme related to Physical Exercise. The following options based on those examples and discussion were provided:

- '*Creation of events related to Physical Exercise*';
- '*Schedule Physical Exercises*';
- '*Creation of a plan of Physical Exercise*';
- '*Share the progress of Physical Exercise*';
- '*Compare the progress of Physical Exercise with friends*';
- '*Associate a reward system to Physical Exercise*';
- '*Audio-visual tutorials related with exercises to practice*';
- '*Simulations on exercises to practice*' and '*Other*.'

The participants' initial assessment towards nutritional status and context

In regards to the participants' nutritional status, the mini-nutritional assessment (MNA)[16] was used to assess anthropometry, dietary interventions and both a global and subjective assessment (with permission given)

The anthropometric assessment encompassed the following variables: Body Weight, Weight loss, Body Mass Index (BMI), Medication, Mobility and Acute disease or Stress. Hence, the participants were weighed on a decimal balance with a total capacity of 150 Kilograms (Kg) whereas the height was measured using a stadiometer and the BMI was then calculated by dividing the body weight by the height. The mean Brachial Perimeter was measured on the non-dominant arm at the midpoint between the acromion and the olecranon whereas the leg circumference was measured at a maximum girth between the knee and the ankle joint.

In terms of the dietary intervention, the following elements were covered: meal frequency, consumption of dairy products, beans/grains or eggs, meat or fish, fruit, vegetables and liquids.

The global assessment comprised the following aspects: medication, psychological stress or acute illness, mobility, neuropsychological problems and pressure ulcers. Finally,

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[16] MNA® website (www.mna-elderly.com) (Access date: October 27th, 2017)

the subjective assessment focused on self-perception relative to nutrition and health, in comparison with other people of the same age.

To assess the participants' perception towards their body image, the Body Appreciation Scale (BAS) was used. The purpose of using this 5-item scale (ranging from 1=never to 5=always) was to assess the participants' level of acceptance, their own favourable opinions and respect for their body. The Internal consistency of the BAS in this study was very satisfactory (Cronbach's alpha = .96) and permission has been given by the authors.[17] The scale included the following items:

1. *I respect my body;*
2. *I feel good about my body;*
3. *On the whole, I am satisfied with my body;*
4. *Despite its flaws, I accept my body for what it is;*
5. *I feel that my body has at least some good qualities;*
6. *I take a positive attitude toward my body;*
7. *I am attentive to my body's needs;*
8. *My self-worth is independent of my body shape or weight;*
9. *I do not focus a lot of energy being concerned with my body shape or weight;*
10. *My feelings toward my body are positive for most part;*
11. *I engage in healthy behaviours to take care of my body;*
12. *I do not allow unrealistically thin (muscular) images of women (men) presented in the media to affect my attitudes toward my body;*
13. *Despite its imperfections, I still like my body.*

In addition to the participants' self-assessment in terms of their nutritional status and their perception of their body image, group discussions were carried out with the purpose

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[17] Although the authors of the scale have recommended to use the updated version of BAS (BAS-2), the researcher had already applied the scale BAS to the participants and this latter was validated in portuguese.

Original version: WHOQOL Group. (1998). Development of the World Health Organization WHOQOL-BREF quality of life assessment. The WHOQOL Group. *Psychological Medicine*, *28*, 551–558.

Portuguese version: Neto, F. (2011). Avaliação psicométrica da Escala de Apreciação Corporal. In *VIII Congresso Iberoamericano de Avaliação/XV Conferência Internacional Avaliação Psicológica: Formas e contextos*. Lisboa.

of understanding: (a) the factors that could influence the participants' dietary habits; (b) whether the participants would be willing to share their dietary progress, with whom and which piece of information; and (c) preferences relative to the use of key performance indicators in terms of dietary habits (*e.g.* Variety in food intake; Frequency of daily meals; Weight and Body Mass Index; Amount of calories, carbohydrates, proteins, fats, among others).

In addition, previous discussions about the main requirements that a learning programme should have in order to encourage good nutrition were carried out with a specialist in the area. The main topics discussed were: the role of social dynamics in health behaviours, literacy in the health context, problems of dehydration and ageing, special diets, dietary intake, oral health and weight.

Based on these requirements, a questionnaire was administered to the participants, aiming at understanding their context relative to Nutrition. Thus, they rated the following statements, using a 5-item scale (ranging from 1=never to 5=always):

1. *"I invite my friends to healthy cooking events"*;
2. *"I read about food in newspapers, magazines, books…"*;
3. *"I read the food labels on the packaging and bottles"*;
4. *"I drink water often"*;
5. *"I have a special diet (vegetarian, with certain vitamin…)"*
6. *"I compulsively eat certain types of food"*;
7. *"I eat certain types of food accordingly with my health needs"*
8. *"My knowledge on dietary habits is fostered through the use of videos…"*
9. *"I buy cookbooks on low-calorie meals"*
10. *"I frequently go to the dentist (e.g. due to problems with chewing food that I usually consume)"*
11. *"I like to weigh myself"*
12. *"I like to look at myself in the mirror"*
13. *"My friends have influence on my eating habits"*

The participants' initial assessment towards sense of security and participation in society

Lastly, the participants were surveyed about their perceived sense of security and Human rights. For example, they were given a list of statements (based on the possible threats to human security exposed by the United Nations (1994), see Chapter 1 "Active Ageing"), in which the participants had to rate from 1 to 5 (1=Totally disagree and 5=Totally agree):

1. *"I feel safe in my home"*;
2. *"I feel safe outside home"*;
3. *"I feel threatened by the environment"*;

These statements (1, 2, and 3) are relative to threats to survival, personal security (*e.g.* physical violence, crime, terrorism, domestic violence, labour exploitation), and environment (*e.g.* pollution, natural diseases, environment degradation, lack of natural resources…). The following sentences (4 and 5) allude to threats to health:

4. *"I feel safe about my health"*;
5. *"I have someone who can help me in case of illness or emergency"*

Finally, the statements 6, 7, 8 and 9 refer to threats to Human dignity, community, economy and abuse of Human Rights:

6. *"I feel discriminated against for some reason"*;
7. *"I feel threatened or harassed"*;
8. *"I feel pressure to practice religion"*;
9. *"I feel that my rights as citizens are respected."*

Beyond these specific threats, the following statement "I do not feel threats to human security" was added in order to assess the participants' perceived sense of security.

Similarly, the participants were given a list of statements relative to Human Rights to rate from 1 to 5 (1=Totally disagree and 5=Totally agree). The following statements were based on the Human Rights presented in Chapter 1 "Active ageing" (UN, 2011):

1. "*I have access to goods and services regardless of my age, gender or physical condition*": This statement refers to the right to freedom from discrimination (access to goods and services, regardless of the individuals' age, gender, physical or mental condition);

2. "*I feel protected from verbal, sexual, financial, psychological abuse…*": This statement is relative to the right to freedom from violence;

3. "*I feel that I have access to social protection*": This statement refers to the right to social security (*e.g.* lack of social protection – pensions, risk of poverty);

4. "*I have access to the health system*": This statement refers to the right to health (healthcare);

5. "*I feel protected against material goods*": This statement is relative to the right to property and inheritance rights;

6. "*I have access to the job market*": This statement is relative to the right to vocational training and access to the market;

7. "*I have access to learning/training activities*": This statement is relative to the right to continuing education;

8. "*I have access to justice and judicial remedies*": This statement refers to the right to have access to justice.

Finally, the following general statement "I feel that my rights are respected" was added in order to assess the participants' perceived sense of security in terms of Human rights.

In terms of the 'Strategic Visioning and Future Workshops' devoted to Security and Participation in Society, the participants have also defined a plan for preventing and addressing the top threats to Human security. For example, the following scenario was posed: "*People are not aware of their rights. As a policy-maker and citizen, it is your mission to solve this problem.*" In two groups, participants had about 10 minutes to discuss the problem and how to solve it.

In ensuring internal validity of the 'Strategic Visioning and Future Workshops' and 'Contextual Inquiry' techniques, the following strategies were used: (a) Carrying out the co-design sessions iteratively with the group G0; (b) Peer debriefing for the content used in the design sessions; and (c) Triangulating multiple sources of data collected (i.e. field notes, questionnaires, document analysis, and repeated observations at research sites).

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B. The participants

The criteria for selecting the subjects were: (a) being aged 50 or older; (b) know how to read and write; (c) voluntary participation; and (d) interest in learning. The initial convenience sample involved in the design process consisted of 37 participants.

Four participants did not satisfy the selection criteria. One did not fit within the age bracket whereas three did not complete all sessions. Therefore, the final convenience sample consisted of 33 participants. Considering the gender of the participants in the co-design sessions, sixteen were male (48.5%) and seventeen were female (51.5%). The average age of the sample was 67 years old (SD=7.06, minimum = 55; maximum = 82) and the majority had between 10 and 14 years of schooling. It is worth mentioning that the sample size follows the principle of saturation (Suter, 2011). In other words, when the repetition and the similarity of behaviours and of the information obtained was verified, there was no need to include more participants in the sample.

C. The Universities of Third Age

In terms of the contact with the Universities of the Third Age, it was established by sending an invitation and a letter of interest in which the scope, research goals and the procedures for carrying out the study were explained. The Universities of Third Age that were interested in participating signed a consent form, giving permission to carry out the research activities, recording and collecting data. The same process was followed with each participant from that university.

The Universities that accepted the invitation of the researcher were four from the Aveiro district. The learners at Universidade Sénior da Gafanha da Nazaré were both involved in the design process (co-design group -G0) and in the Quantitative Experimental Research (experimental group – G1, comparison group – G2 and control group – G3), whereas the Academia de Cultura e Solidariedade de Águeda, Academia de Saberes de Aveiro and Universidade Sénior de Oliveira de Azeméis only participated in the Quantitative Experimental Research (G1, G2 and G3). The following is a brief description of their mission and learning activities:

Universidade Sénior da Gafanha da Nazaré

The main aim of the *Universidade Sénior da Gafanha da Nazaré* is to encourage active ageing through the promotion of cultural and educational activities. The courses offered include English, Informatics, Photography and Communication, Gardening, Dancing, Music, Sewing, and Arts.

Academia de Cultura e Solidariedade de Águeda

The main aim of the *Academia de Cultura e Solidariedade de Águeda* is to encourage active ageing through education to culture and civic engagement. The courses offered include English, Informatics, Hydro gymnastics, and Image Consulting.

Academia de Saberes de Aveiro

The main aim of the *Academia de Saberes de Aveiro* is to foster both the participation of the adult learners in society and the cooperation between different generations, through knowledge sharing and the organisation of cultural, social and recreational activities. The courses offered include English, Handicrafts, Communication, Dance, Yoga, Informatics, Cognitive Activity, Pilates, Mindfulness, Theatre, History of Religion, Painting and Gardening.

Universidade Sénior de Oliveira de Azeméis

The main aim of the *Universidade Sénior de Oliveira de Azeméis* is to encourage knowledge sharing among the learners and develop sociocultural and leisure initiatives. The courses offered include Embroidery, Cutting and Sewing, Cooking, Theatre, French, History, Painting, Portuguese, and Music.

As can be observed in these brief descriptions of the Universities of Third Age, their aims are in accordance with the main goal of this research project (develop a game-based learning programme for affecting active active ageing). The sessions for this research study were integrated in the Informatics syllabus (with the exception of Academia de Saberes de Aveiro, in which the experiments were carried out as 'extracurricular activities').

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C. The role of the researcher

In the qualitative study, the researcher has a fundamental role in collecting, interpreting and attributing meaning to data. On the one hand, some level of experience is required to conduct the group discussions, collecting information and analysing the data. On the other hand, being familiar with the participants who will be involved in the research project can bring certain biases to the study.

Involving the participants in the design process of the digital artefacts is not new for me. I have taken part in the research project 'SEDUCE – Senior Citizen Use of Computer-Mediated Communication and Information in Web Ecologies' [18] and one of the main activities was to co-design online services with the full participation of the subjects for the development of an online social community. In addition, I also collaborated on the course 'Introduction to Multimedia' for older adults at the University of Aveiro and carried out face-to-face and online focus groups with gamers aged 50 and over, aiming at designing Networked video games for older adults.[19]

Despite being familiar with the process of mentoring these co-design sessions, I would bring certain biases to the study if the participants were the same. Being in contact with the participants twice a week for more than a year goes beyond the mere relationship 'researcher – participants' and this fact can compromise the objectivity in collecting and interpreting the data.

5.1.4 PHASE 2: The Quantitative Experimental Research

A two-treatment counterbalanced design with a control group was conducted in order to test whether there were significant differences between the type of experiment undertaken (the use of game-based learning or the computer assisted platform). In addition, the main psychosocial variables that game designers should take into account when designing and assessing games for active ageing were explored.

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[18] Information about the research project:
http://www.seduce.pt/SITE_EN/project.html (Access date: October 27th, 2017)

[19] Costa, L. (2013, June). *Networked video games for older adults*. Master's Thesis. University of Aveiro, Aveiro, Portugal.

Sixty (60) adult learners at four Universities of Third Age were enrolled in the study. They were randomly assigned to three different groups: The Experimental group (G1), who tested firstly a Game-Based Learning Programme (GBLP) and then a Computer-Assisted Learning Programme (CALP); The Comparison group (G2), who tested firstly the CALP and then the GBLP and the Control group (G3) that did not take part in the intervention. Participants were then assessed on their perception of health-related wellbeing and quality of life, using the SF36-v2 and WHOQOL-BREF scales before and after each experiment.

A. Setting and data collection

Data from the participants were gathered between March 2017 and June 2017 and this two-treatment counterbalanced design with a control group involved three assessment phases.

Table 10 illustrates the main activities carried out during a 6-week session experiment (3-week sessions devoted to game testing and 3-week sessions devoted to video-based online course).

As can be observed from Table 10, the participants were given information about the research project and consent form in the first Assessment Session. Then, the three groups were assessed in terms of their perceived wellbeing and quality of life, using the scales WHOQOL-BREF and SF36v2.

The Experimental Group (G1) and Comparison Group (G2) were subjected to the different experiments (GBLP and CALP), following an activity guide and at the end of each session, the main strengths and weaknesses of both platforms were discussed. At the midpoint of the different experiences (Beginning of Session 4) and at the end of Session 6, the participants' perception of wellbeing and quality of life were re-assessed.

All experimental sessions were conducted in groups and *in loco*. Data collection was based on the application of the scales, direct observation and group discussion.

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Table 10. Activities carried out during the 6-week session experiment

Session number	Activities
Assessment Session 1	The researcher greeted the participants and explained the research objectives, procedures, benefits, risks and rights of the participants. Questions and Answers (Q&A) followed and consent was obtained from the participants.
Assessment Session 2	The session begun with the self-administered surveys: WHOQOL-BREF and SF36v2 (Baseline). The Experimental Group (G1) tested the Game-based Learning Programme whereas the Comparison Group (G2) tested the Computer-Assisted Learning Programme. Participants were given an activity guide for each activity and at the end of the session, the main strengths and weaknesses of both platforms were discussed.
Assessment Session 3	The Experimental Group (G1) tested the Game-based Learning Programme whereas the Comparison Group (G2) tested the Computer-Assisted Learning Programme. Participants were given an activity guide for each activity and at the end of the session, the main strengths and weaknesses of both platforms were discussed.
Assessment Session 4	The session begun with self-administered surveys: WHOQOL-BREF and SF36v2 (Midpoint). The Experimental Group (G1) tested the Computer-Assisted Learning Programme whereas the Comparison Group (G2) tested the Game-Based Learning Programme. Participants were given an activity guide for each activity and at the end of the session, the main strengths and weaknesses of both platforms were discussed.
Assessment Session 5	The Experimental Group (G1) tested the Computer-Assisted Learning Programme whereas the Comparison Group (G2) tested the Game-based Learning Programme. Participants were given an activity guide for each activity and at the end of the session the main strengths and weaknesses of both platforms were discussed.
Assessment Session 6	This Session was completed with self-administered surveys WHOQOL-BREF and SF36v2 (Posttest).

B. The participants

The inclusion criteria for selecting the participants were the following: (i) being 50 or older; (ii) know how to read and write; (iii) voluntary participation; and (iv) interest in learning. The participants were 60 adult learners at four Portuguese Universities of Third

Age enrolled in the study (see *C. The Universities of Third Age*). Twenty (20) participants (50% males, 50% females; M= 73 years old, SD=5.93) tested firstly a Game-Based Learning Programme (GBLP) and then a Computer-Assisted Learning Programme (CALP) (experimental group); 20 participants (40% males, 60% females; M= 69 years old, SD=6.35) tested firstly the CALP and then the GBLP (group of comparison); and 20 participants did not take part in the intervention (35% males, 65% females; M= 69 years old, SD= 7.16). In terms of these participants' education level, 38.3% (N=23) had a University Degree, 21.7% (N=13) had 1-4 years of schooling, 16.7% (N=10) had 7-9 years of schooling; 11.7% (N=7) had 10-12 years of schooling; 8.3% (N=5) had 5-6 years of schooling and 3.3% (N=2) had a Post-graduate degree. There are not significant statistical differences between the 3 sample groups regarding their age (F=.728, p=.487), gender (x2(2)=2.19, p>.05) and their education level (x2(10)=7.28, p>.50)

C. Measures and Analysis

The instruments used in this study were the SF36v2 short form and the WHOQOL-BREF.

The SF36v2 form aims to assess the perception on health-related wellbeing and comprises of two health component summary measures (physical and mental) and the following eight health domains: Physical Functioning, Role participation with physical health problems (Role-Physical), Bodily -Pain, General Health, Vitality, Social Functioning, Role participation with emotional health problems (Role-Emotional) and Mental Health. For each domain, the following items are included:

- *Physical Functioning:* This domain covers information about the participants' limitations in performing physical activities (i.e. vigorous activities; lifting and carrying groceries; climbing stairs; bending, kneeling or stooping; walking moderate distances; and self-care activities);

- *Role-Physical:* This domain covers information about the participants' limitations in physical health (i.e. limitations in work or daily-life activities; amount of time spent and difficulties in performing these daily activities; and accomplish less than expected)

- *Bodily Pain:* This domain covers information about the participants' perceived intensity of pain felt and its impact on daily activities;

- *General Health:* This domain covers information about the participants' overall perceived health status and expectations towards their own health;

- *Vitality:* This domain covers information about the participants' energy level, fatigue and subjective wellbeing;

- *Social Functioning:* This domain covers the impact of physical and emotional problems on social activities;

- *Role-Emotional:* This domain covers information about the participants' limitations in mental health (i.e. amount of work and time spent on daily activities; the care with which the activities were performed);

- *Mental Health:* This domain covers information about the participants' mental health (i.e. anxiety, depression; loss of behavioural/emotional control; and psychological wellbeing);

In this study, the perceived changes in health status were assessed relative to a 1-week recall and the Permission to use SF36v2 was given by Quality Metric. The answers provided by the participants for each of the three data collection sessions were very consistent (The Response Consistency Index ranged from 0.133 to 0.883), level of completeness was 100% and the Cronbach's Alpha was .967.

The WHOQOL-BREF is a 26-item scale that has the purpose of assessing the perception on quality of life[20], taking into account four dimensions: perception of the physical condition, perception of the emotional and cognitive condition, perception of the

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[20] Permission was given by the WhoQoL Group

Original version: Neto, F. (2011). Avaliação psicométrica da Escala de Apreciação Corporal. In *VIII Congresso Iberoamericano de Avaliação/XV Conferência Internacional Avaliação Psicológica: Formas e contextos*. Lisboa.

Portuguese version: Vaz Serra, A., Canavarro, M. C., Simões, M., Pereira, M., Gameiro, S., Quartilho, M. J., ... & Paredes, T. (2006). Estudos psicométricos do instrumento de avaliação da qualidade de vida da Organização Mundial de Saúde (WHOQOL-Bref) para Português de Portugal. In *Psiquiatria clínica* (Vol. 27, No. 1, pp. 41-49).

number and quality of social relationships, and self-awareness of own context and environment. In other words, this scale is divided into the following domains:

- *Physical Health:* This domain covers information about the participants' physical health (i.e. activities of daily living; dependence on medicinal substances and medical aids; energy and fatigue; mobility; pain and discomfort; sleep and rest; work capacity);

- *Psychological:* This domain covers information about the participants' psychological state (i.e. bodily image and appearance; negative feelings; positive feelings; self-esteem; spirituality/religion/personal beliefs; thinking, learning, memory and concentration);

- *Social relationships:* This domain covers information about the participants' social relationships (i.e. personal relationships; social support; and sexual activity);

- *Environment:* This domain covers information about the participants' environmental context (i.e. financial resources; freedom, physical safety and security; health and social care: accessibility and quality; home environment; opportunities for acquiring new information and skills; opportunities for recreation/leisure activities; physical environment (pollution/ noise/ traffic / climate); and transport.

The level of completeness for this scale was 98.93% and the Cronbach's Alpha was .919.

Data analysis was performed using SPSS Statistics 23 and QualityMetric's Health Outcomes Scoring Software 5.0. The first group of participants to be assessed in terms of the use of platforms were also asked to share their opinions on the way that these could affect active ageing. The following topics have emerged during this discussion: Confidence to solve Daily Problems; Motivation to Participate in the Community; Decrease in Ageing Bias/Not being afraid of the Ageing Process; and Find Solutions to Problems. Then, all participants from the Experimental Group (G1) and Comparison Group (G2) were asked to rate their experience, using a scale from 0 (0=Never) to 4 (4=Always).

5.1.5 PHASE 3: The Mixed-method Research

In this Phase, the information obtained in the previous phases (PHASE 0, PHASE 1, and PHASE 2) was compiled and crossed with the data obtained from group discussions with G1 and G2 about the pros and cons of each experiment and a set of recommendations provided by a group of experts in the domains of Games, Human-Computer Interaction, Psychology and/or Ageing Studies.

According to Glaser and Strauss (2006), many of the challenges in social research can be met through the use of Grounded Theory (GT). Indeed, when delving into such changeable phenomena as trends in the game market and design for health and active ageing, a theory grounded in data obtained *in situ* and at the moment rather than relying on pre-determined information seems to be the most suitable practice. Hence, the inductive approach used in Grounded Theory was also applied to this research in order to collect the information and analysing the interrelationship between the concepts emerged on the data obtained from group discussions with G1 and G2 about the pros and cons of each experiment (cooperative evaluation of the prototypes) and a set of semi-structured interviews with Subject Matter Experts in the fields of Games, Human-Computer Interaction, Psychology and/or Ageing Studies. In a nutshell, this information has been crossed with the information obtained in the previous phases (PHASE 0, PHASE 1, and PHASE 2)

A. Cooperative evaluation of the prototypes with G1 and G2

After the co-design process and the game development, a cooperative evaluation with 40 adult learners (Experimental Group - G1 and Comparison Group- G2) was followed.

This evaluation had the purpose of identifying the main strengths and problems when experiencing the co-designed game platform, and understanding the way this Game-Based Learning Programme (GBLP) could encourage active ageing and healthy lifestyles. Therefore, the participants were asked about the main strengths, weaknesses, and suggestions for improvement in the game as well as the way the game platform could encourage active ageing.

Relative to the latter question ("In what way a game-based learning platform could encourage active ageing?"), a set of categories were used based on the first evaluation with the co-design groups' answers and then ranked for each category using the scale: Never, Rarely, Sometimes, Usually and Always.

B. The Interview with Subject Matter Experts

The Interview Questions

Before proceeding to examine the research questions posed in the interview, it is necessary to revisit the research question and main purpose of this research. Considering that the research question is *"In what way can game-based learning affect active ageing?"*, exploring the main design components that game-based learning should have for encouraging active ageing was essential. Based on this research objective, a number of questions were formulated in order to gather the interviewee's perspectives on the use of game-based learning for active ageing.

Table 11 provides an overview of the questions used to interview subject matter experts in the fields of Games/Human-Computer Interaction and Psychology/Marketing/Ageing Studies. The questions were then divided in the following: data collection questions and data analysis questions.

These questions were then chosen and adjusted to the profile/background of the interviewee. In regards to the profile of experts in Games or Human-Computer Interaction, two additional questions were added that were related with the involvement of the end-users in the design process and the monetization aspects of a game (depending on whether the interviewees were familiarized with the involvement of the end-users in the design process and monetization in games). The questions were the following:

1. *In what way can we involve the end users in the design process without compromising the designer's authorship?*
2. *What is your view on co-design versus only involving the player in the gameplay testing?* and
3. *For you, what would be the best way to monetize a game?*

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Based on these pre-determined questions, an interview protocol was then formulated and followed. However, there was some flexibility in regards to the questions posed and the interviews were semi-structured, lasting approximately 60 minutes.

Table 11. Overview of questions used to interview Subject Matter Experts

Interviews with Experts in the fields of Games/Human-Computer Interaction (Questions)

Data collection questions	Data analysis questions
1) How can we attract the player's attention to the information transmitted and changes in behaviour through a game-based approach? / How do you see gamification in the context of learning and changes in behaviours?	What are the main factors that can foster learning and changes in behaviour?
2) In your opinion, what could be a pervasive game scenario for motivating active ageing and healthy lifestyles?	
3) Do you see gamification as a players' mind-set solution or a game designer's product? Why?	What's the role of game designers in gamification?
4) Can a gamified system work by extending actions that occur in the physical space to the digital one? What is your view on that?	What's the role of players' mind-set in gamification?
5) How can games generate a culture of care and prevention outside of the medical system?	What are the main factors that can generate a culture of care and prevention outside of the medical system?
6) In your perspective, what role can informational literacy perform in order to overcome the commercial war that can occur between changing or manipulating behaviours?	What are the main strategies that can be adopted in order to avoid manipulation of behaviours in gamification?
7) What are the main misconceptions or drawbacks of these game-based approaches that game designers should take into account?	What are the drawbacks/challenges of the game-based approaches for learning and changes in behaviours?
8) What are the opportunities for gamification and serious games?	What are the opportunities for gamification and serious games?
9) In your opinion, what the future holds for serious games and gamification?	

Table 11. Overview of questions used to interview Subject Matter Experts (cont.)

Interviews with Experts in the fields of Psychology/Marketing (Questions)

Data collection questions	Data analysis questions
1) What drives human behaviours?	What are the main factors that drive human behaviour?
2) In your opinion, can technologies trigger changes in behaviour? If so, in what way?	What are the key technological features that can influence changes in behaviours?
3) How can we transform human behaviours into daily routines?	What are the main factors that lead human behaviours into habits/routines?

Interviews with Experts in the Ageing Studies (Questions)

1) In your opinion, how can we create environments that are better places for encouraging active ageing?	What are the main features of an age-friendly environment?
2) In your perspective, what could the technology industry do to contribute to age-friendly contexts?	What are the opportunities for age-friendly technologies?
3) What challenges do you foresee in the new approaches to create age-friendly environments?	What are the challenges for age-friendly technologies?

Procedures

The interviews were conducted by the researcher during a research internship at Coventry University. Firstly, a set of questions were prepared accordingly with each interviewee's profile (expertise in Game Design, Human-Computer Interaction or expertise in Psychology and/or Ageing Studies). A number of possible interviewees were then contacted and out of the 52 sent invitations, there were 10 acceptances, 2 refusals and 40 no answers. Seven interviews were conducted (face-to-face, telephone and e-mail interviews), audiotaped and transcribed. The face-to-face interviews took place at the Coventry University and a convenient time was arranged for both the interviewee and the interviewer. During the interviews, the interviewees were invited to expand on their initial responses.

In regards to the data analysis, the transcriptions were reread and coded. The interviewees were assigned an ID number and the patterns of their statements were identified and highlighted. The concepts were then compared and connected.

In order to assure the validity and reliability of the analysis made, member checking was used in order to review the codes used and its interconnection. The interviewees were also invited to review the transcriptions.

The interviewees

The interviewees involved in this research were Subject Matter Experts from the Educational Sector and the Industry or Society in the fields of Games, Human-Computer Interaction, Psychology, Marketing and Ageing Studies. The rationale for including these interviewee's profiles as criteria was the following:

a. get their perspective on the use of games in learning and changes in behaviours; and

b. understand the role of digitally-mediated approaches to meet the challenges of the ageing process.

In a total of 38 possible interviewees, who were invited by email to participate in this study, ten accepted the invitation. Of the ten interviewees, eight were male and two females. Six of the interviewees were researchers whereas three were practitioners in the game industry and one was both researcher and practitioner in the game industry. General information about the interviewees is shown in Table 12.

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Table 12. Participants' general information

ID	Context	Description
1	Educational Sector	Researcher in user experience and information architecture. Professor in Computer Science with a vast experience in joint academia-industry projects (e.g. *Microsoft, Nokia*)
2	Both	Freelance game designer, consultant and lecturer. Experience in game development and previous involvement in such game projects as the ones carried out by Bullfrog Productions or Madden NFL Football.
3	Industry	Vast experience in the game industry and consultant in monetisation, videogames and gamification. Relevant game projects: Smashy City, Batman and The Flash: Hero Run, Jelly Jiggle and Farm All Day.
4	Educational Sector	Research Associate at the Disruptive Media Learning Lab. Background in Psychology with the following research interests: identities in online communities, learning practices and games.
5	Industry	Vast experience in the tabletop games industry and involvement in various game projects (i.e. triple A console MMOs and free-to-play games).
6	Industry	Vast experience in game design. Relevant game projects included SEGA Rally Revo and Colin McRae: DiRT Rally.
7	Educational Sector	Professor and Researcher with expertise in 'silver gaming' and the use of old and new media by older adults.
8	Educational Sector	Research fellow for the Behaviour and Interventions Research Group (Coventry University) and Public Health Warwickshire with the following research interests: evidence informed making, social marketing, health behaviour change and eHealth.
9	Educational Sector	Researcher in Educational Technology and Learning Design at Simon Fraser University with a focus on ageing and technology. Research interests: digital games and digital storytelling with older adults and intergenerational relationships.
10	Educational Sector	Senior lecturer and researcher with background in artificial intelligence, in-game learning, computer games development and digital media. Research interests: virtual reality and applications for learning and training.

Interview protocol

A protocol for conducting the interviews and analysing the data was followed. The protocol was divided into the following steps:

1. Introduction/ Instructions and Standards procedures
2. Ice-breaker question
3. 4/5 questions
4. Thank-you statement

The tables below (Table 13, Table 14 and Table 15) illustrate the process used in each interview relative to the different interviewee's profiles.

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Table 13. Interview protocol A

(Domain Experts in the areas of Games/Human-Computer Interaction)

Purpose	An interview is designed to prompt domain experts in the areas of games and ageing studies for a description of the main design components that game-based learning should have in order to encourage active ageing and healthy lifestyles.
Introduction (5 min)	*"Thank you very much to participating in this interview. My name is Liliana Costa, I am a Ph.D. student in Information and Communication in Digital Platforms at the University of Aveiro, Portugal and I am doing an internship at the University of Coventry. The aim of this research is to assess the potential of game-based learning to encourage active ageing and healthy lifestyles. As a domain expert in the field of games, you have been invited to share your views on games and how we can use them in learning and changes in behaviours. The interview will take approx. 60 minutes. Does that still work for you? All collected data will be made anonymous so that no inferences about your identity may be drawn. Would you mind if I audio-recorded this interview for subsequent transcription? All data will be kept password-protected on my personal computer inaccessible to third parties. There are no right or wrong answers, rather individual views so feel free to share your points of view. Do you have any questions before we start off? "*
Icebreaking Question (10 min)	*"Maybe you could briefly introduce yourself and say a few words about your research/background/experience in studying digital games"* or *"How did you begin your adventure on 'Serious Games'?"* or *"How did you decide to become a researcher in digital games?"* or *"How did you embark on the digital game industry?"*
4/5 questions (40 min)	*"How do you see gamification in the context of learning and changes in behaviours?"* or *"In your opinion, what could be a pervasive game scenario for motivating active ageing and healthy lifestyles?"* or *"Do you see gamification as a player's mindset solution or a game designer's product? Why?"* or *"What are the opportunities for gamification and serious games?"* or "How can games generate a culture of care and prevention outside of the medical system?", etc. (see Table 10, section A. The Interview Questions)
Ending (5 min)	*Ok. That is the end of our interview. Is there anything you would like to add or talk about that has not been covered so far? I hope you have enjoyed as me. Thank you for your participation. Any comment, please feel free to contact me.*

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Table 14. Interview protocol B

(Domain Experts in the areas of Psychology)

Purpose	An interview is designed to prompt domain experts in the area of psychology for a description of the main design components that game-based learning should have in order to encourage active ageing and healthy lifestyles.
Introduction (5 min)	*"Thank you very much to participating in this interview. My name is Liliana Costa, I am a Ph.D. student in Information and Communication in Digital Platforms at the University of Aveiro, Portugal and I am doing an internship at the University of Coventry. The aim of this research is to assess the potential of game-based learning to encourage active ageing and healthy lifestyles. As a domain expert in the field of psychology, you have been invited to share your views on the main factors that drive Human behaviours, the key technological features that can influence changes in behaviours and, the main factors/elements that lead human behaviours into habits/routines. The interview will take approx. 60 minutes. Does that still work for you? All collected data will be made anonymous so that no inferences about your identity may be drawn. Would you mind if I audio-recorded this interview for subsequent transcription? All data will be kept password-protected on my personal computer inaccessible to third parties. There are no right or wrong answers, rather individual views so feel free to share your points of view. Do you have any questions before we start off? "*
Icebreaking Question (10 min)	*"Maybe you could briefly introduce yourself and say a few words about your research/background/experience"* or *"Maybe you could introduce your organization and say a few words about its initial aim and how the organization has evolved since then."*
4/5 questions (40 min)	*"What drives Human behaviours?"*, *"In your opinion, can technologies trigger changes in behaviour? If so, in what way?"*, *"How can we transform a Human behaviour into a daily routine?"*, etc. (see Table 10, section A. The Interview Questions)
Ending (5 min)	*Ok. That is the end of our interview. Is there anything you would like to add or talk about that has not been covered so far? I hope you have enjoyed as me. Thank you for your participation. Any comment, please feel free to contact me.*

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Table 15. Interview protocol C

(Domain Experts in the areas of Ageing Studies)

Purpose	An interview is designed to prompt domain experts in the area of psychology for a description of the main design components that game-based learning should have in order to encourage active ageing and healthy lifestyles.
Introduction (5 min)	*"Thank you very much to participating in this interview. My name is Liliana Costa, I am a Ph.D. student in Information and Communication in Digital Platforms at the University of Aveiro, Portugal and I am doing an internship at the University of Coventry. The aim of this research is to assess the potential of game-based learning to encourage active ageing and healthy lifestyles. As a domain expert in the field of ageing studies, you have been invited to share your views on age-friendly technologies and how we can use them in learning and changes in behaviours. The interview will take approx. 60 minutes. Does that still work for you? All collected data will be made anonymous so that no inferences about your identity may be drawn. Would you mind if I audio-recorded this interview for subsequent transcription? All data will be kept password-protected on my personal computer inaccessible to third parties. There are no right or wrong answers, rather individual views so feel free to share your points of view. Do you have any questions before we start off? "*
Icebreaking Question (10 min)	*"Maybe you could briefly introduce yourself and say a few words about your research/background/experience"* or *"Maybe you could introduce your organization and say a few words about its initial aim and how the organization has evolved since then."*
4/5 questions (40 min)	*"In your opinion, how can we create environments that are better places for encouraging active ageing?"*, *"In your perspective, what could the technology industry do to contribute to age-friendly contexts?"*, *"What challenges do you foresee in the new approaches to create age-friendly environments?"*, etc. (see Table 10, section A. The Interview Questions)
Ending (5 min)	*Ok. That is the end of our interview. Is there anything you would like to add or talk about that has not been covered so far? I hope you have enjoyed as me. Thank you for your participation. Any comment, please feel free to contact me.*

5.2 Ethical considerations

This study is part of the research project SeriousGiggle (SFRH/BD/101042/2014), which has been approved by the Ethics Committee of the University of Aveiro (Resolution n. 3/2015) that safeguards, among other things: (a) The informed consent of the participants aged 50 and over; (b) voluntary participation; (c) involvement of the research team in the process; and (d) that the risks of participating in the study do not outweigh the risks associated with the participants' daily lives.

A. Experimental research design

Relative to the experimental research design, there were a set of ethical issues that were anticipated in this study in order to protect the participants and assure the integrity of the research. The main ethical procedures to minimize the potential risks were the following:

1. Obtain the participants' consent to take part in the research project

   The participants formally consent to participate in the research. A consent letter informs the participants about the circumstances under which the study is carried out, the purpose of the research, the potential risks and benefits of the research, the right to withdraw at any time and to refuse to answer any question. The researchers assure that all participants understand the terms of any agreement before taking part in the research project. A letter of permission is also given to the Universities of Third Age, indicating the title of the project, the researcher's names, the duration, the purpose and further information related with the research project.

2. Protect the participants' identity and treat them with respect

   The researchers assure the confidentiality and the privacy of the data as well as ensure that the private information is not released outside. When reporting the results, only the relevant information to the purpose of the study is written. Furthermore, all participants are randomly identified with a P and a number. The electronic files of observation notes, audio and video files are kept in secured locations protected by password.

3. Explain the purpose, procedures and the duration of the group discussion and interviews

    In each group discussion, the main purpose, the procedures and the duration of the different sessions are explained. Although the interview questions could present the risk of bringing up emotions related with the sense of wellbeing and quality of life, the researcher would stop asking questions if that constituted harm to the participant and assumed this fact as a limitation of the study. The participants were informed when the information was being recorded and the out-of-record data was respected.

4. Assure the quality of the content lectured in the learning programs

    The researcher responsible for conducting these learning programs was in charge to study about the content (Health, Security and Citizenship/Participation in life) and plan each session and get an opinion from experts in the areas of Health, Security, Education and Social Affairs to assess the plan of the learning sessions.

5. Ask for permission to use the SF36V2 and WHOQOL-BREF scales

    Permissions were given from the authors of SF36V2 and WHOQOL-BREF scales.

B. Interviews

In regards to the interview, the interviewees were given a consent form that informed about the way the information would be used and the right to stop or withdraw from the research at any time. By signing that form, the participant agreed with the following: (a) The interview would be recorded and a transcript produced; (b) Direct quotations or summary interview content would be anonymized; (c) The recording would be destroyed after 5 years; (d) The recording would be destroyed after 5 years; (e) The participants would voluntarily take part in the project and had the right to stop or withdraw at any time; and (f) The right to ask any questions the participants could have.

Overall, the research project followed different code of ethics regarding the ethical issues previously reported: the APA Ethical Principles of Psychologists and Code of Conduct (§ 1.08; 2.01, 3.10 - 3.11, 4.01- 4.06, 5.04, 7.01-7.03, 7.06 8.02, 8.03, 9.02,

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9.07)[21], the American Sociological Association (ASA) Code of Ethics (§ 11, 12, 18.01, 18.02)[22], and the American Educational Research Association (§ 12.01, 12.02, 12.03, 12.04, 13.01, 13.02, 18.01, 18.02).[23]

In the APA Ethical Principles of Psychologists and Code of Conduct, the research project followed the principles of Competence, Human Relations, Privacy and Confidentiality, Advertising and Other Public Statements, Education and Training, Research and Publication and Assessment.

In the Code of Ethics from the ASA and the Educational Research Associations, the principles that served the project ethical issues were: Principle of Confidentiality, Informed Consent and Education, Teaching and Training.

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[21] APA Ethical Principles of Psychologists and Code of Conduct
 http://www.apa.org/ethics/code/ethics-code-2017.pdf (Access date: Aug 28th, 2017)

[22] APA Ethical Principles of Psychologists and Code of Conduct
http://www.asanet.org/membership/code-ethics (Access date: Aug 28th, 2017)

[23] Code of Ethics from the ASA and the Educational Research Associations
http://www.aera.net/Portals/38/docs/About_AERA/CodeOfEthics(1).pdf (Access date: Aug 28th, 2017)

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6 The effectiveness of the learning programmes[24]

«Change is the end result of all true learning»

– Leo Buscaglia (as cited Parker, 1994, p. 37)

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[24] Part of the content of this Chapter has been published in the following papers:

Costa LV, Veloso AI. (2017). Demystifying Ageing Bias Through Learning. In: Beck D, Allison C, Morgado L, Pirker J, Khosmood F, Richter J, et al. (Eds.), *Immersive Learning Research Network: Third International Conference,* iLRN 2017, Coimbra, Portugal, June 26-29, 2017, Cham: Springer International Publishing; 2017. p. 201–13. Doi: http://dx.doi.org/10.1007/978-3-319-60633-0_17

Costa, L. V., & Veloso, A. I. (2017). Co-Designing a Game Based Learning Platform for Active Ageing: The Case of "Jump." In *GAME-ON'2017, 18th Annual Conference on Simulation and AI in Computer Games.*

Costa, L. V., & Veloso, A. I. (2016). "'Game-based psychotherapy' for active ageing: A game design proposal in non-game context". In *Proceedings of the TISHW 2016 - 1st International Conference on Technology and Innovation in Sports, Health and Wellbeing, Vila Real, 1-3 Dec. 2016*, USA: IEE 2016, 1-8. Doi: https://doi.org/10.1109/TISHW.2016.7847788

Costa, L. V., Loizou, M., Arnab, S., & Veloso, A. I. (2017). *Games for Active Ageing, Wellbeing and Quality of Life: A Pilot Study.* In press

Costa, L. V., Loizou, M., Arnab, S., & Veloso, A. I. (2017). *Breaking barriers to game-based learning for active ageing and healthy lifestyles: A qualitative interview with experts on the field.* In press

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6 The effectiveness of the learning programmes

This Chapter analyses the learners' perception towards wellbeing and quality of life before, during and after the use of the learning programmes. The results encompass the initial assessment of the participants' contexts of the co-design group, the two prototypes (a digital game and a computer-assisted platform) that were developed[25], both the design and psychosocial factors that should be taken into account when designing and assessing these platforms and recommendations to develop a game-based learning strategy.

6.1 The results of a mixed-method research

6.1.1. PHASE 1: The Participatory Action Research (Qualitative Phase)

As aforementioned in Chapter 5 (p.129), the development of both learning platforms followed a Participatory Action Research (PAR) approach and involved 33 adult learners at a University of Third Age (48.5% male and 51.5% female, M=67 years old, minimum = 55; maximum = 82).

In this Chapter, the following topics will be presented: the context of the participants (initial assessment), the development of the Computer-Assisted Learning Programme

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[25] Although the reader could expect the prototypes and the initial assessment of the participants' contexts of the co-design group to come under the Method Chapter, the author decided to present it in the Chapter 'The effectiveness of the learning programmes' as these are seen as an important outcome of the thesis that resulted from the co-design sessions.

(CALP) and the Game-Based Learning Programme (GBLP) and the design implications on wellbeing and quality of life.

The participants' initial assessment towards cognitive activity/learning

When the participants of the co-design sessions (G0) were asked about their main motivations to adhere to a learning programme and learning preferences, the strongest reasons that they pointed out were: foster life-long learning (N=28, 84.8%); and improve self-esteem, self-confidence, cognitive capacity and personal fulfilment (N=21, 93.9%). Only four participants (12.1%) have enrolled a course delivered at distance and the main reasons that they have pointed out were: flexibility in schedules; and personalization of the learning programmes to the learner's context.

Relative to the participants' learning preferences, the participants were given a number of statements to rate from 1 (1= totally disagree) to 5 (5= totally agree). These statements are categorized into the following styles: Behaviourism (BH), Cognitivism (CG) and Constructivism (CT) (Table 16).

As can be seen in Table 16, constructivism tends to be the learning style preferred by the participants (in 6 out of 8 sentences, the mean was 4 points or over). In general, the participants are likely to enjoy sharing information with people who have common interests (M=4.31, SD= 0.93).

They also consider that learning is a discovery process (M=4.43, SD=0.68) and it is likely to be effective when words and images are displayed rather than only images (M=4.43; SD=0.63) and schemas are presented relative to the learning content (M=4.26, SD=0.82).

Thus far, the learning platforms should enable the participants to share information with those who have common interests and present multimodal texts and schemas that illustrate the learning content. These results corroborate the implications for designing meaningful learning environments based on age-related changes and the principles of adult learning presented in Chapter 2 (p.59).

Table 16. Participants' perception towards their learning style

		Mean	SD
BH	1. My surroundings affect my learning process (e.g. place, people…)	3.77	1.14
	2. New apprenticeships influence my behaviours.	3.07	1.19
	3. I like that the goals of the training activities, which I participate, are presented.	4.21	0.77
	4. I learn a lot through observation of others' behaviours, attitudes and herein consequences.	4.10	0.72
CG	5. I like when schemas are presented relative to the learning content.	4.26	0.82
	6. I learn better if words and images are displayed rather than only images.	4.43	0.63
	7. Learning is a discovery process.	4.43	0.68
	8. Emotions have a strong influence on my learning process.	3.87	1.01
	9. My success in training activities depends on my effort.	4.10	0.99
	10. My success in training activities depends on the difficulty level of the task.	3.68	1.08
	11. My success in training activities depends on the luck factor.	2.23	1.22
	12. I often select only the information that interests me.	3.59	1.27
	13. I like to start with simple challenges and then move on to the more difficult ones.	3.97	0.91
	14. I like examples to be presented about what I am learning.	4.19	0.93
CT	15. I like to participate in group activities.	4.06	0.99
	16. I like to build my own knowledge.	3.88	0.98
	16. I enjoy sharing information with people who have common interests.	4.31	0.93
	17. I enjoy learning challenges.	4.00	0.95
	18. I like to solve problems based on previous experiences.	4.19	0.89
	19. I like to use Information and Communication Technologies (ICT) to learn and share information.	3.81	1.01
	20. I enjoy sharing knowledge with people with the same interests as me.	4.25	0.92
	21. I enjoy learning challenges that meet my learning capacities.	4.03	0.95

During the co-design sessions, the participants were surveyed about the following topics: participation in learning events, learning challenges, mentoring, video-based

content, learning exercises, share of knowledge, mentor's skills, self-contribution to the learning process, division of the content per modules, use of social media in learning, linking the learning content to daily life, learning plan, learning progression and learning profile, notifications about the learning content, self-assessment, rewards and certification.

The participants emphasised that the skills that they wanted to practice with such a learning programme were: Problem-solving (Strategy), Memory and Attention, Logic and Reaction time. The following is an excerpt from the researchers' diary relative to the theme of 'Learning and cognitive activity':

> *The session started with co-design sessions relative to cognitive activity. The participants manifested their willing to participate either in a face-to-face or online course in the morning (11h-13h) or at night (21h). The skills that they would want to practice are: Problem-solving (Strategy), Memory and Attention, Logic and Reaction time.*

> - Researchers' diary
> May 5th, 2015

These skills are also in accordance with the previous research conducted by the author in which a survey to 245 gamers aged 50 and over has revealed that the skills that they would like to practice with a game were: Problem-solving, Spatial and Temporal Memory skills and Calculation (See Chapter 3, p.93).

The participants found the following topics to be important and relevant to their motivations and needs: the possibility to go to face-to-face learning events (e.g. round tables...); solve problems related with the learning content; share the learning content with friends; get challenges that are linked with daily lives; and contribute with own content to the course. The following is a brief overview of some exemplar quotes from the participants that illustrate their motivations to the learning activities:

> *"I am ready to receive all provided information because, even in the simple things, there will always be something to learn. Solving problems related with the content is the key to learn."*

> – Participant (University of Third Age)

"There is so much to learn in field trips. What do you think professor? That field trip to 'Casa de Camilo Castelo Branco' was worth it, fun and we learned together. Being in the field is what it is... We should have another field trip"

– Participant (University of Third Age)

"As long as the learning content is suitable for our daily lives, it is fine. By the way, you could build a learning space where we could share photos and information"

– Participant (University of Third Age)

Furthermore, the curriculum vitae/information about the tutor and the reliability of the source of information were considered to be one of the most important elements in the learning process. Although the certification of the course was not seen as a fundamental factor, checking and monitoring the competences achieved with a course was one of the leading factors that affected their adherence to the course.

The following is a brief overview of some exemplar quotes from the participants:

"As I do not need this [learning course] to a career or to get a job, surveying about certification of the course or the competences achieved does not make sense. Now, stating the competences that was achieved and the progress made is very important."

– Participant (University of Third Age)

"It is very important that the professor says whether what I am doing is right or wrong [...]"

– Participant (University of Third Age)

In addition, these participants follow the 'Bring Your Device' philosophy. All participants bring their own devices to the classes and when asked about it, the participants pointed out their difficulty to reproduce the exercises or the solutions to their doubts at home.

"One thing is to show in a computer that is not my own and then I come home and nothing seems to work. That is why I bring my computer and mobile phone [...]"

– Participant (University of Third Age)

Collectively, these results outline the main implications for designing the learning programmes (GBLP and CALP). Thus, these learning programmes should take into account the following elements: (a) cognitive challenges (improve cognitive capacity); (b) monitor the participants' progress in the platform and reward their activity (improve self-esteem, self-confidence and personal fulfilment); (c) be flexible in terms of timetable (flexibility in schedules); (d) enable information sharing with people who have common interests; (d) foster self-discovery and scaffolding; (e) organise the learning content in terms of goals/missions; (f) present multimodal texts and schemas that illustrate the learning content; (g) connect the learning content and goals to daily activities; (h) enable the participants to contribute with their own content to the course; and (i) provide information about the 'source of information.'

The participants' perceived concept of active ageing

On the question of the participants' own concept of active ageing, the main aspects that they highlighted were related with Functionality and Contribution to society; Health; Willing; and Quality of Life. Table 17 shows the effects matrix for the coded statements.

From the Table 17, we can see that Functionality and Contribution to Society is the most cited aspect related to the participants' own definition of active ageing. Hence, fostering both a role in society and physical and cognitive activities are extremely relevant.

Although much focus is given towards health and contribution, the participants' definitions are in accordance with the framework of Active Ageing provided by the World Health Organisation (2002) (see Chapter 1, p. 24). These results highlight the importance that both cognitive and physical activities and participation in society have for designing the learning programmes (GBLP and CALP). In addition, the design of such learning programmes should take into account the placement of 'call-to-actions' and the quality of life   domains.

Table 17. Effects Matrix for Coded Statements (Definition of Active Ageing)

Themes	Number of Statements	Exemplar quotes
Functionality & contribution to society	16	*'Practice different activities – e.g. sports, learning activities…'* *'Practice certain activities – either physical or mental.'*
Health	9	*'Overcome the lack of clarity and consistent definitions.'* *'Walk in life with adequate health conditions.'*
Wiling	4	*'Have the desire to be helpful and learn.'* *'Willing to live with less worries.'* *'A man only ages when dreams become wailings'*
Quality of Life	4	*'Ageing with quality of life'* *'Living with quality in the post-employment phase of life'*

The participants' initial assessment towards Physical Exercise

Relative to the theme of Physical Exercise, the group discussions with the participants (G0) began with the definition and importance of physical exercise. The following is an excerpt from the researchers' diary relative to the theme of 'Physical Exercise':

The session 1 started with the definition and importance of Physical Exercise. One of the participants has asked: 'In the past, people had to not worry about Physical Exercise. Why being concerned about that now?' I have cited the work carried out by Toffler – The Third Wave.[26] We discussed the 3 waves that society have passed over the years – The First Wave (Agricultural Society), The Second Wave (Industrial Age) and The Third Wave (Post-industrial Society) and in what way these phenomena have also influenced the way Physical Exercise moved from an obligation for survival to an option. The model of behaviours proposed by Prochaska and Diclemente[27] was shown and all the participants mentioned that they were in the

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[26] Toffler, A. (1981). The Third Wave. New York: Bantam books.

[27] Prochaska, J. O., & DiClemente, C. C. (2005). The transtheoretical approach. In J. Norcross & M. Goldfried (Eds.) Handbook of Psychotherapy Integration, Oxford, UK: Oxford University Press, 147–171.

Action/Maintenance phase and that social support networks were essential to maintain physical exercise in their routines.

- Researchers' diary
March 13, 2015

As shown in this excerpt, reinforcing social support networks in order to encouraging physical exercise was one of the requirements of these platforms. Relative to the type of exercises to practice and Key Performance Indicators (KPI), the following passage of the researcher's diary is also relevant in order to make later the design decisions:

The session started with the presentation of the biological effects of the ageing process and the influence of physical exercise on fall prevention. Then, the participants were given a set of physical exercises to perform and classify in terms of difficulty. According to the participants, the most difficult exercises were: (a) The foot and ankle In and Out and (b) The flexion exercise. Breathing exercises were the ones they have found that were the most important at their age, followed by balance and speed exercises. The following are some of the participants' sentences: 'I would choose breathing exercises. Brain oxygenation is very important in order to rejuvenate our cells and in some way delaying the effects of the ageing process.' Or 'Breathing exercises are important but I'd also add balance exercises. They are fundamental to fall prevention.' Overall, the participants summarized their own views by prioritizing the exercises regarding the level of importance as: (1) Breathing exercises; (2) Balance exercises; and (3) Speed exercises. Concerning their preferences for monitoring Physical Exercises, the participants stress that the indicators to be recorded would be time frequency and the accuracy of the exercises performed. In general, the participants would want to share the calories spent and the blood glucose levels with friends and health professionals [...]

- Researchers' diary
March 20, 2015

As explained above, the type of Physical Exercises that should be incorporated in the learning programmes are: Breathing, Balance and Speed exercises. In terms of the assessment of the participants' performance, the following indicators were the most cited

to be the most relevant: time frequency and accuracy of the exercises performed. In addition, these participants would want to share the calories spent and the blood glucose levels with friends and health professionals.

When the participants were surveyed whether they practised any Physical Exercise, the main reasons for practising or not practising Physical Exercise and the place chosen to do exercise, 18 out of 33 participants (54.5%) stated that they do Physical Exercise at least 3 times per week and the main reasons pointed out by the participants who did physical exercise were: Improve agility and posture (N=20; 60.6%); Prevent health problems (N=17; 51.5%); and Maintain and improve mobility (N=15; 45.5%). There were six participants, who did not practice any Physical Exercise and highlighted 'lack of motivation/interest' as being the main reason. The participants also mentioned that the best place to do exercise would be outdoors, followed by gym or the University of Third Age.

Results have also shown that the majority of the participants agreed that doing exercise with people of the same age was good for socializing (N=31; 94%). In addition, they recognised that doing it in a balanced way was essential to good health (N=33; 100%) and helped them to relieve anxiety and to cope with emotions (N=31; 94%), being more fun in groups rather than individual exercises (N=32; 99%). Overall, Physical Exercise was stated to be important to general health (N=32; 99%).

Relative to the question: "*What are the main functionalities that you would like to have in a learning programme related to Physical Exercise?*", Table 18 shows the main functionalities that a learning programme related to Physical Exercise should have.

As shown in Table 18, the main functionalities that participants chose for a learning programme to encourage Physical Exercise were: Schedule Physical Exercises (N=19, 57.6%); Share the progress of Physical Exercise (N=19, 57.6%); and Simulations on exercises to practice (N=15, 45.5%).

In a nutshell, the design requirements for both platforms in terms of Physical Exercise were: (a) include breathing exercises beyond agility and balance exercises; (b) use time frequency and accuracy of the exercises performed as Key Performance Indicators (KPI); (c) reinforce social support networks in order to encouraging Physical Exercise; (d) enable the participants to schedule Physical Exercises and share their progress; and (e) simulate exercises to practice.

Table 18. Participants' preferences towards a learning programme for encouraging Physical Exercise

	No Important		Neutral		Important		No Answer	
	N	(%)	N	(%)	N	(%)	N	(%)
Creation of events related to Physical Exercise'	7	21.2	9	27.3	11	33.3	6	18.2
Schedule Physical Exercises	3	9.1	8	24.3	19	57.6	3	9
Creation of a plan of Physical Exercise	4	12.1	9	27.3	18	54.6	2	6
Share the progress of Physical Exercise	7	21.2	6	18.2	19	57.6	1	3
Compare the progress of Physical Exercise with friends	5	15.2	16	48.5	9	27.3	3	9
Associate a reward system to Physical Exercise	13	39.4	7	21.2	8	24.2	5	15.2
Audio-visual tutorials related with exercises to practice	9	27.3	11	33.3	9	27.3	4	12.1
Simulations on exercises to practice	7	21.2	6	18.2	15	45.4	5	15.2

The participants' initial assessment towards nutritional status and context

The following is an excerpt from the researchers' diary relative to the theme of 'Nutrition':

> *The session 2 started with the presentation of the factors that can influence our diet and the different types of diets (Mediterranean diet, Asian diet, Vegetarianism). Then, the participants discussed the major factors that influence their diet. They emphasized the following factors (1) socio-economic status; (2) geography and; (3) cultural tradition. In addition, they noted that if I asked them 20 years ago, the religion would be the main factor but as time changes, they recognise that it does not longer influence their diet. [...] They would like to share with a Health Professional information relative to the quantity of carbohydrates, proteins and fats consumed. For them, this is the most important piece of information to be shared with Health Professionals (even more important than a diet plan). Although a calculator for*

recommended water intake would be not so important as they have revealed that it depends on the individual needs, they'd like to be remembered that they needed to drink water daily. The frequency and variety of dietary intake and the quantity of calories, carbohydrates and fats consumed are the type of information they have considered to a monitoring app.

-   Researchers' diary
April 10-24, 2015

Based on these data, the following functional requirements were defined to design both platforms: (a) Present different types of diets and how the individuals' diet can be influenced by external factors; (b) Offer the possibility to share the types of nutrients consumed and inform the participants about macro- and micro-nutrients; (c) Draw participants' attention to drink water daily; and (d) Enable the participants to plan and manage cooking events.

In regards to the participants' nutritional status, results have shown that out of the 33 participants, 31 had a normal nutritional status (MNA Score > 24) and 2 were at risk of malnutrition (17<MNA Score <= 23.5). The mean BMI was 26.32 (SD=1.77), which indicated that there was a predominance for overweightness. Relative to the anthropometric assessment based on the gender of participants, a Mann-Witney test indicated that the participants' weight (U= 28, p=.000) and height (U= 3.5, p=.000) were greater for male than female (Table 19).

As observed in the Table 19, there were no significant differences between genders relative to the Body Mass Index, Brachial Perimeter, Leg Circumference or Weight Loss. The majority of participants (N=18) have also reported that they had not lost weight during the last 3 months.

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Table 19. Anthropometric assessment based on Gender

	Gender			
	Male		Female	
	Mean	SD	Mean	SD
Weight (Kg)*[M]	83.29	9.64	65.33	11.84
Height (m)*[M]	1.70	0.52	1.58	0.04
BMI (Kg/m^2)	28.76	3.86	26.39	4.00

*[*] $p < 0.05$; [M] Man- Witney test

Table 19. Anthropometric assessment based on Gender (cont.)

	Gender			
	Male		Female	
	N	(%)	N	(%)
Total	16	48.5	17	51.5
Body Mass Index (BMI)				
BMI < 19	0	0	0	0
19 ≤ BMI < 21	1	100	0	0
21 ≤ BMI < 23	2	28.6	5	71.4
BMI ≥ 23	13	52.0	12	48.0
Brachial Perimeter (BPM)				
BPM<21	1	100	0	0
21 ≤ BPM < 22	0	0	2	100
BPM > 22	15	50	15	50
Leg Circumference (LC)				
LC < 31	0	0	2	100
LC ≥ 31	16	51.6	15	48.4
Weight Loss (WL)				
WL > 3 Kg	0	0	1	100
1 ≤ WL ≤ 3	5	83.3	1	16.7
No weight loss	8	44.4	10	55.6
Doesn't know	3	37.5	5	62.5

Comparisons of the anthropometric variables relative to different age groups were also made (Table 20). The age cohorts took into account previous studies (Fisk et al., 2009; Zheng, Hill, & Gardner, 2012) that divide age groups into: "pre-senior" aged between 50 and 64, "young-old adults" aged between 65 and 74 and "old-old adults" aged 75 and over.

In terms of the dietary intervention, the majority of the participants have between 2 and 3 meals per day (N=29; N= 87.9%) whereas four participants (N=4; 12.1%) have 1 or 2 meals per day. Twenty-eight participants (N=28; 84.8%) have revealed that they consume at least 1 portion of dairy products; thirty-one participants (N=31; 93.9%) consume beans/grains or eggs per week; and thirty-two (N=32; 97%) consume meat or fish daily. Relative to the servings fruits or vegetables and the amount of fluid (i.e. water, juice, coffee, tea, milk…) consumed, twenty-nine participants (N=29; 87.9%) eat two or more servings of vegetables daily and only eleven participants (N=11; 33.3%) have more than 5 cups of water or another fluid.

A considerable number of participants have at least three prescribed medicines per day (N=16, 48.5%) and the majority self-feed without any problem (N=27, 81.8%). Although only two out of thirty-three participants (N=2; 6%) have dementia or depression, eight participants (24.2%) had suffered psychological stress or acute disease in the past three months.

Table 20. Anthropometric assessment based on Age Groups[28]

| | Age groups | | | | | |
| | 50-64 | | 65-74 | | +75 | |
	Mean	SD	Mean	SD	Mean	SD
Weight (Kg)	70.46	14.51	73.53	14.30	80.93	12.04
Height (m)	1.65	0.10	1.62	0.67	1.68	0.06
BMI (Kg/m^2)	25.5	1.79	26.5	1.82	27	1.30

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[28] A number of researchers (Fisk et al., 2012; Zheng et al., 2012) consider the following age cohorts: "pre-senior" aged between 50 and 64, "young-old adults" aged between 65 and 74 and "old-old adults" aged 75 and over.

Table 20. Anthropometric assessment based on Age Groups (cont.)

	Age groups					
	50-64		65-74		+75	
	N	(%)	N	(%)	N	(%)
Total	9	27.3	18	54.5	6	18.2
Body Mass Index (BMI)						
BMI < 19	0	0	0	0	0	0
19 ≤ BMI < 21	1	100	0	0	0	0
21 ≤ BMI < 23	3	42.85	3	42.85	1	14.3
BMI ≥ 23	5	20	15	60	5	20
Brachial Perimeter (BPM)						
BPM<21	0	0	0	0	0	0
21 ≤ BPM < 22	0	0	2	66.67	1	33.33
BPM > 22	9	30	16	53.33	5	16.67
Leg Circumference (LC)						
LC < 31	1	50	1	50	0	0
LC ≥ 31	8	25.8	17	54.8	6	19.4
Weight Loss (WL)						
WL > 3 Kg	0	0	1	100	0	0
1 ≤ WL ≤ 3	1	16.67	2	33.33	3	50
No weight loss	5	27.78	12	66.67	1	5.56
Doesn't know	3	33.3	3	16.7	2	33.3

Finally, twenty-eight participants (N=28; 84.8%) do not consider to have any nutritional problem and twenty-six (N=26; 78.8%) consider their health status as good as or better than any other people of the same age. It is worth mentioning that this perception of health status was greater for male than female (U= 83, p=.004)[29] (Table 21).

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[29] The Mann-Witney test was used in order to compare differences between Male and Female (independent variables) and their perception of their health status (dependent variable, ordinal scale)

Table 21. Participants' perception of health status based on gender

In comparison with other people of the other people of the same age, how do you consider your health status?	Gender*[M]			
	Male		Female	
	N	(%)	N	(%)
Not so good	0	0	3	100
Does not know	2	50	2	50
As good	6	40	9	60
Better	8	72.72	3	27.28

[*] $p<0.05$; [M] Mann-Witney test

In regards to the participants' perception towards their body image, the results of the Body Appreciation Scale (BAS) have revealed that some items (i.e. *I feel that my body has at least some good qualities; I engage in healthy behaviours to take care of my body; Despite its imperfections, I still like my body*) varied accordingly with gender. These differences are illustrated in Table 22 and as can be seen from the data presented, women seemed to be more positive towards their body image than men.

The Mann-Witney test also suggested that women recognised more the good qualities of their bodies than men (U= 78, p=.02); they engaged more in healthy behaviours to take care of their body (U= 82, p=.04); and that they still like their body, despite its imperfections (U= 75.5, p=.001). Overall, these results have revealed that the learning programme should take into account the participants' concern with their body shape and weight as well as the body images presented in both platforms.

Table 22. Body Appreciation Scale (BAS) items and Gender

	Gender			
	Male		Female	
	Mean	SD	Mean	SD
1. I respect my body.	3.88	1.15	4.19	1.38
2. I feel good about my body.	3.69	1.01	4.13	1.25
3. On the whole, I am satisfied with my body.	4.00	1.16	4.06	1.06
4. Despite its flaws, I accept my body for what it is.	4.38	0.72	4.56	0.73
5. I feel that my body has at least some good qualities.* M	3.94	1.24	4.57	0.76
6. I take a positive attitude toward my body.	3.81	0.98	4.20	0.94
7. I am attentive to my body's needs.	3.63	1.09	4.07	1.16
8. My self-worth s independent of my body shape or weight.	3.60	1.40	4.40	1.12
9. I do not focus a lot of energy being concerned with my body shape or weight.	3.31	1.30	2.87	1.25
10. My feelings toward my body are positive for most part.	3.94	1.12	4.38	0.81
11. I engage in healthy behaviours to take care of my body. * M	3.44	1.03	4.06	0.85
12. I do not allow unrealistically thin (muscular) images of women (men) presented in the media to affect my attitudes toward my body.	2.94	1.73	3.25	1.88
13. Despite its imperfections, I still like my body. * M	4.19	1.11	4.79	0.43

* p<0.05; M Man- Witney test

Finally, relative to the questionnaire that was administered to the participants about their nutritional context, Table 23 presents the statements that were the most rated and that have implications for the design of the learning programmes.

As can be observed in Table 23, the participants of the co-design group (G0) usually read about food in newspapers, magazines, books (Male M=3.38, SD=1.09; Female M=4.00, SD=0.97); drink water often (Male M=3.31, SD=1.67; Female M=4.13, SD=0.96); like to weigh themselves (Male M=3.44; SD=1.26; Female M=3.87; SD=1.06); and eat accordingly with their health needs (Male M=3.44; SD=1.41; Female M=3.07; SD=1.94).

The Mann-Witney has revealed that women like to look after themselves more than men
(U= 51, p=.02), weigh themselves and are less influenced by their friends on their eating
habits.

Table 23. Participants' additional context based on Gender

	Gender			
	Male		Female	
	Mean	SD	Mean	SD
1. I invite my friends to healthy cooking events	2.44	1.41	2.40	1.50
2. I read about food in newspapers, magazines, books…	3.38	1.09	4.00	0.97
3. I read the food labels on the packaging and bottles	3.19	1.38	3.94	1.06
4. I drink water often	3.31	1.67	4.13	0.96
5. I have a special diet (vegetarian, with certain vitamin...)	2.27	1.49	2.14	1.17
6. I compulsively eat certain types of food	2.19	1.42	1.93	1.54
7. I eat certain types of food accordingly with my health needs	3.44	1.41	3.07	1.94
8. My knowledge on dietary habits is fostered through the use of movies, videos…	3.00	1.56	2.81	1.91
9. I buy cookbooks on low-calorie meals	2.06	1.69	2.33	1.45
10. I frequently go to the dentist (e.g. due to problems with chewing food that I usually consume).	1.88	1.26	1.47	1.19
11. I like to weigh myself.	3.44	1.26	3.87	1.06
12. I like to look at myself in the mirror * M	2.94	1.29	4.20	0.78
12. My friends have influence on my eating habits.	2.13	1.26	1.80	1.01

* p<0.05; M Man-Witney test

Overall, the design requirements for both platforms in terms of nutrition were: (a)
present different types of diets and how the individuals' diet can be influenced by external
factors; (b) offer the possibility to share the type of nutrients consumed and inform the
participants about macro- and micro-nutrients; (c) draw the participants' attention to drink
water daily; (d) enable the participants to plan and manage cooking events; (e) take into
account the participants' concern with their body shape and weight as well as the body

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images presented in both platforms; and (f) provide information about the nutrients of certain types of food.

The participants' initial assessment towards sense of security and participation in society

On the question of the participants' perceived threats to human security, results have shown that 17 participants (51.5%) felt that their rights were respected. The participants also reported that they felt as secure as the previous year (N=23, 69.7%) and equally to people of the same age (N=24, 72.7%).

Table 24 shows the participants' general perception towards their sense of security (rated from 1 to 5, 1=Totally disagree and 5=Totally agree). As can be seen from the data presented, the participants felt that they were safe in home and had someone who can help them in case of illness or emergency. However, they seem to not feel as safe outside as in their homes. In fact, 24 participants (72.8%) have reported to feel safe in home whereas only 13 (39.4%) feel safe outside home.

Table 24. Participants' perception towards their sense of security

	Mean	SD
1. I feel safe in my home.	4.10	0.94
2. I feel safe outside home.	3.13	1.21
3. I feel discriminated against for some reason.	1.94	1.35
4. I feel safe about my health.	3.65	1.17
5. I feel threatened by the environment.	3.31	1.20
6. I feel threatened or harassed.	1.90	1.51
7. I feel pressure to practice religion.	1.26	0.99
8. I feel that my rights as citizen are respected.	3.48	1.53
9. I have someone who can help me in case of illness or emergency.	4.03	0.82
10. I do not feel threats to my human security.	3.03	1.68

In addition, 13 participants (N=13, 39.4%) felt threatened by the environment (*e.g.* environmental degradation, pollution, lack of natural resources and natural disasters).

A Mann-Witney test was performed in order to check whether there was any difference between men and women in terms of their perception towards their sense of security. The

results have suggested that men felt more discriminated against for some reason rather than women (U=71.5, p=.03).

In terms of Human Rights (Table 25), only three participants (N=3, 9.1%) had access to the labour market and four felt (N=4, 12.2%) felt that their participation in political decisions was valued. Nevertheless, the majority of participants felt that they had access to health (N=25, 75.8%) and to goods or services, regardless of their age, gender, physical or mental conditions (N=25, 75.7%).

Table 25. Participants' perception towards their Human Rights

	Mean	SD
11. I have access to goods and services regardless of my age, gender or physical condition.	4.30	0.75
12. I feel protected from verbal, sexual, financial, psychological abuse…	3.57	1.59
13. I feel that I have access to social protection.	3.90	1.39
14. I have access to the health system.	4.30	0.95
15. I have access to the job market.	1.57	1.59
16. I have access to learning/training initiatives.	3.58	1.42
17. I feel that my participation in the political decisions valued.	1.73	1.82
12. I have access to justice and judicial remedies	2.59	2.02
13. I feel protected against material goods	3.38	1.41
14. I feel that my rights are respected	3.46	1.55

When analysing the differences in the participants' perception towards their Human Rights based on their age group, the Kruskal-Wallis[30] test have revealed that there were differences between age groups relative to justice and judicial remedies ($\chi2$ (2) = 7.24, p=.03). Indeed, the group aged between 65-74 years old were the ones who reported to have more access to justice and judicial remedies (N=8, 44.4%) in comparison with the 50-64 group (N=2, 22.2%) or the +75 group (N=0, 0%).

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[30] The Kruskal-Wallis test was used in order to compare differences between age groups (50-64; 65-74, +75 group) (independent variables) and their perception of Human Rights (dependent variable, ordinal scale)

Moreover, ten participants (30.3%) were volunteers at least in one volunteering initiative and most of them were local initiatives. The main reasons for adhering to such initiatives were: Help other people, Meet people, and Improve self-esteem.

During the design sessions, the participants have also defined a plan for preventing and addressing the top threats to human security. For example, the following scenario was posed: "*People are not aware of their rights. As a policy-maker and citizen, it is your mission to solve this problem.*" In two groups, participants have had about 10 minutes to discuss the problem and how to solve it. Figure 22 shows that solutions proposed to this problem were 'Encourage the search for information', 'Create awareness of NGO's interventions' and 'Retain Human Rights' by simulating a scenario, in which the player can interfere and change it.

Additional threats to human security that participants found relevant to address in their plan were Human dignity and Environmental crisis. The prevention plan involved the following actions: reinforce intervention in non-governmental organizations, communitarian actions, environmental education and information about the cycle of the products. Finally, the proposed solutions were: Simulate a real scenario in which basic Human rights were often violated in order to educate for Human dignity, and Change the source of energy and the materials used.

Not being aware of own rights
(lack of purpose/life in community)

Encourage the search for information

Create awareness of NGO's interventions

Retain human rights

Educate to human dignity
(Perceived threats to human security)

Simulate a scenario in which we have to interfere
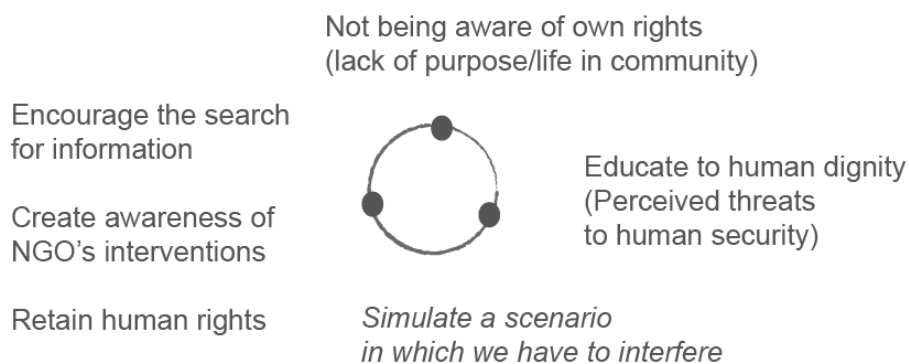
Figure 22: Illustrative example of the application of the problem-solving, using scenario building

Given the different threats to Human security and the Human rights, there are a number of ways in which participants can contribute to society. A set of group discussions were carried out in order to define a plan for addressing two out of the eight of the Millennium

Development Goals: Primary education; Promote gender equality and empower women; Reduce child mortality; Improve maternal health; Combat HIV/AIDS, malaria and other diseases; Ensure environmental sustainability; and Global partnership for development. The participants prioritised the goals and had chosen 'Eradicate extreme poverty and hunger' and 'Ensure environmental sustainability', in order to discuss a set of strategies to explore in the mediated game-based artefact. For each goal, the following elements were defined: Intervention/Resources, Strategies and Impact.

For example, the following strategies were defined to overcome the goal 'Eradicate extreme poverty and hunger': Reuse wastes; Minimize social gaps; Provide access to water supply; and Run learning programmes to manage resources. As these strategies demand Human and material resources and can have an environmental impact, the following actions were defined to address the goal of 'Ensuring environmental sustainability': Foster communitarian actions; Reinforce environment education and Strengthen cooperation between different entities (i.e. local entities, international organizations, citizens). These actions demand the use of clean technology and can have an impact on the environment and society.

Some of the problems to solve in both game scenario and the transference of game design elements and game thinking into non-game contexts were related with ways of contributing to these Millennium Development Goals. Based on the information provided during these sessions, history-based scenarios in which Human Rights would be at risk were simulated in order to encourage players to think and act upon the scenario given.

In a nutshell, the design requirements for both platforms in terms of security and participation in society were: (a) the possibility of using the learning programme at home but assist the adult learner outdoors; (b) encourage the participants to act upon their environment and political decisions; and (c) simulate a real scenario in which basic Human Rights were violated and educate for Human dignity and rights.

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Development of the Game-Based Learning Programme (GBLP)

The game-based learning programme is entitled 'Jump'[31] and was designed with the purpose of demystifying ageing bias and encouraging a positive attitude towards the ageing process. The content covered is the same as the one presented in the computer-assisted learning platform, being divided into the following themes: Health, Security and Participation in Society. A group of undergraduate students in the New Technologies of Communication (NTC) were involved in the implementation process of the game-based learning programme, mentored by myself and Prof. Ana Isabel Veloso.

The game premise was the following:

> *"Sul, the city's fisherman, is tired of getting stuck to a routine that he never got used to. Depressed and isolated, Sul has to face the storyteller Nubel, who forces him to a time travel experience, in order to recover values and a significant meaning to his own life."*

- JUMP team

Although the game premise was a result of the team's creative authorship, the possibility to travel to different places as game activity (Figure 23) was based on the participants' reported favourite activity during the co-design activities. Indeed, time traveling encompassed the following scenarios: 1) Paris, France 1948; 2) Hizen, Japan 1709; and 3) London, England 1895.

The game was embedded in an informative website and although the final version of the game has not incorporated the interaction of Unity 3D with the MySQL database due to time constraints, a code sample and the database (Figure 24) were provided to the students by the researcher and hence this process was also illustrated in the architecture system (Figure 25).

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[31] JUMP (English version): http://jump.web.ua.pt/en/ (Access date: Nov 5th, 2017)
JUMP (Portuguese version): http://jump.web.ua.pt/ (Access date: Nov 5th, 2017)
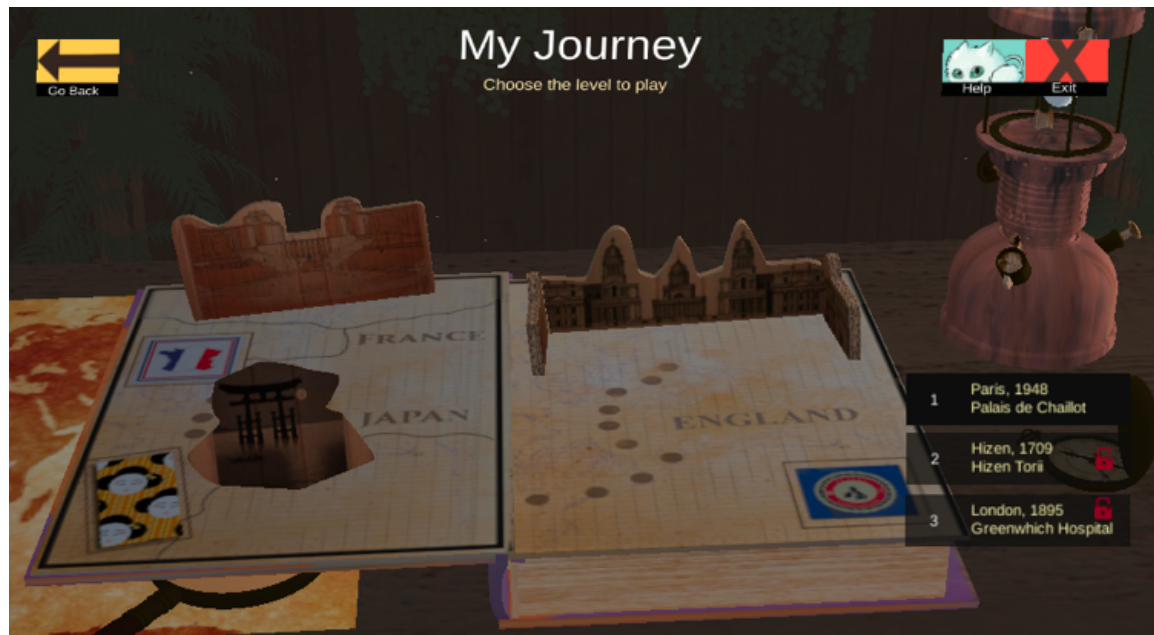
Figure 23: Game Menu – Players' Journey to different places[32]

As can be seen in Figure 24, the JUMP database entails the following elements:

- *Player:* Information relative to the name, email and password are stored;

- *Missions:* These missions can be accomplished both in-game and in the physical space. Although these missions have been designed to appear on a 'Mission screen' and be recalled by a game companion 'Jumpy', these were presented off-game as an alternative (in the website) (Figure 26). The energy/progress of player in the game is also dependent on the amount of cups of water (0/8) that (s)he has drunk on that day;

- *Rewards:* The player is rewarded for each mission accomplished through the use of experience points (ordered in a ranking);

- *Social:* The player can discuss the learning content with other players (off-game). This functionality was later replaced by a Disqus Comment System.[33]

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[32] The Game Scenarios and characters have been developed by the researcher, jointly with the members of the JUMP team

[33] *Disqus* Comment System: Plug-in used to implement the discussion area (disqus.com) (Access date: October 27th, 2017)
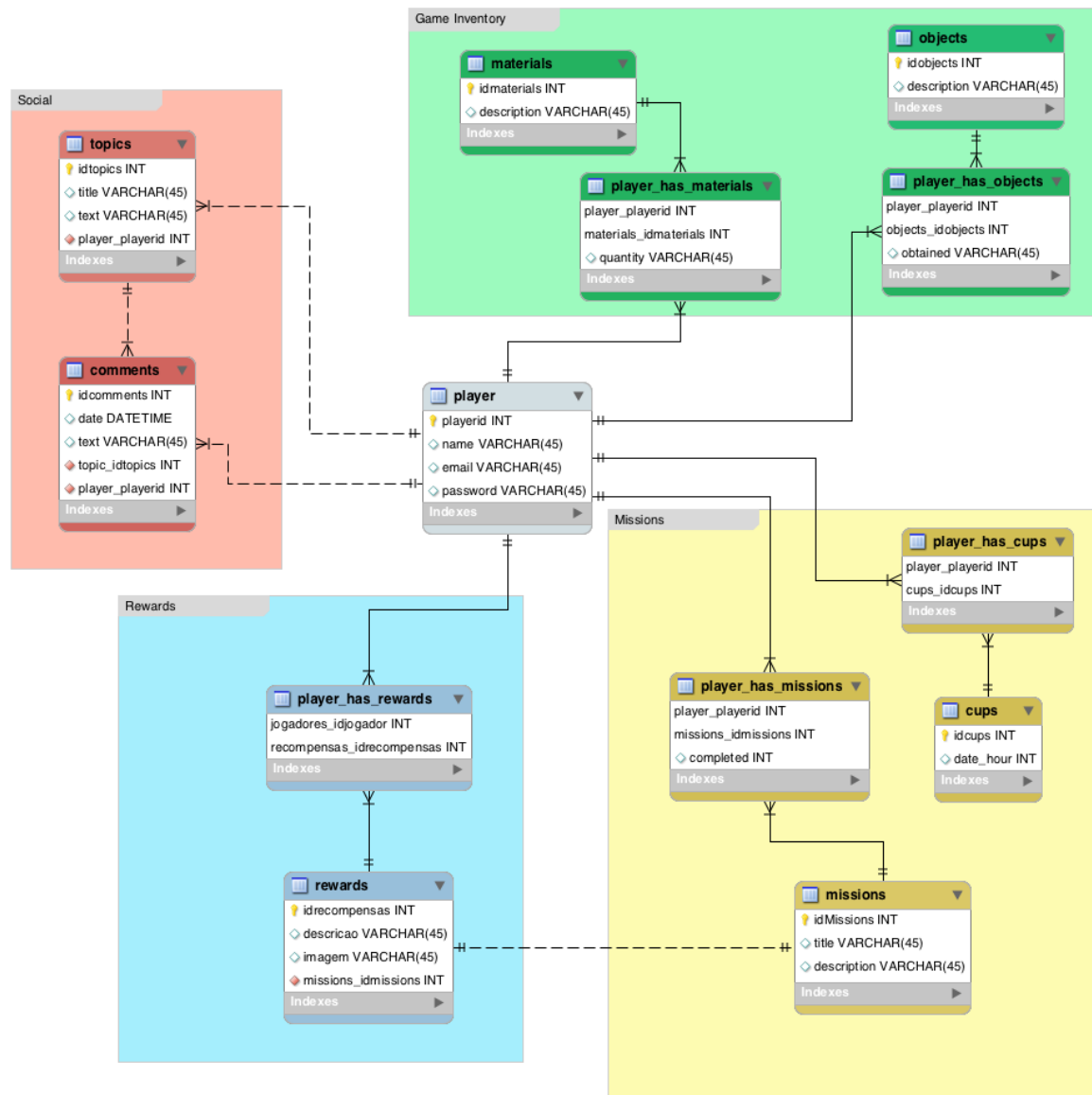
Figure 24: JUMP database

The game architecture system (Figure 25) can be also divided into two areas: client-side (visible to the player) and server-side (with the database). The player has access to the system through a browser, by typing the url and play the embedded Unity 3D application.

The division between private and public areas is established through the login session. In fact, the information about the game and the game team is displayed in the public area whereas the game, missions and social area are displayed in the private area. In order to play the game, the player goes to the webpage and login in the platform. Then, he/she waits while the game is loaded.
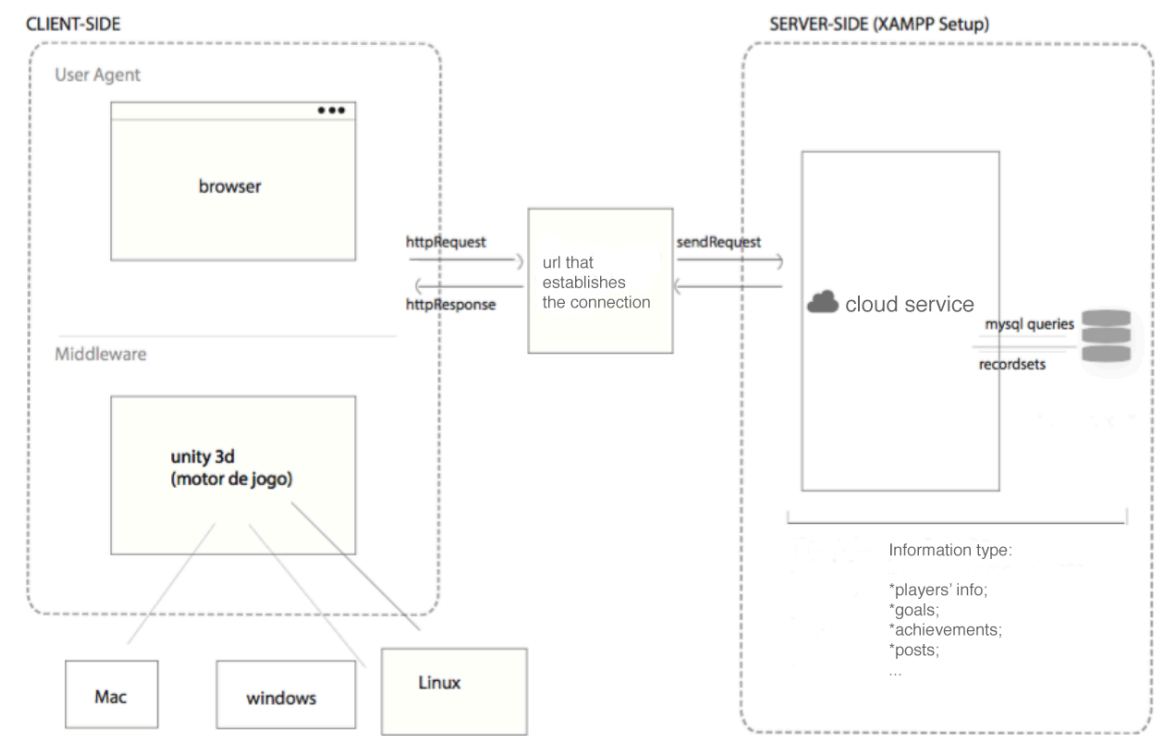
Figure 25: Game Architecture System
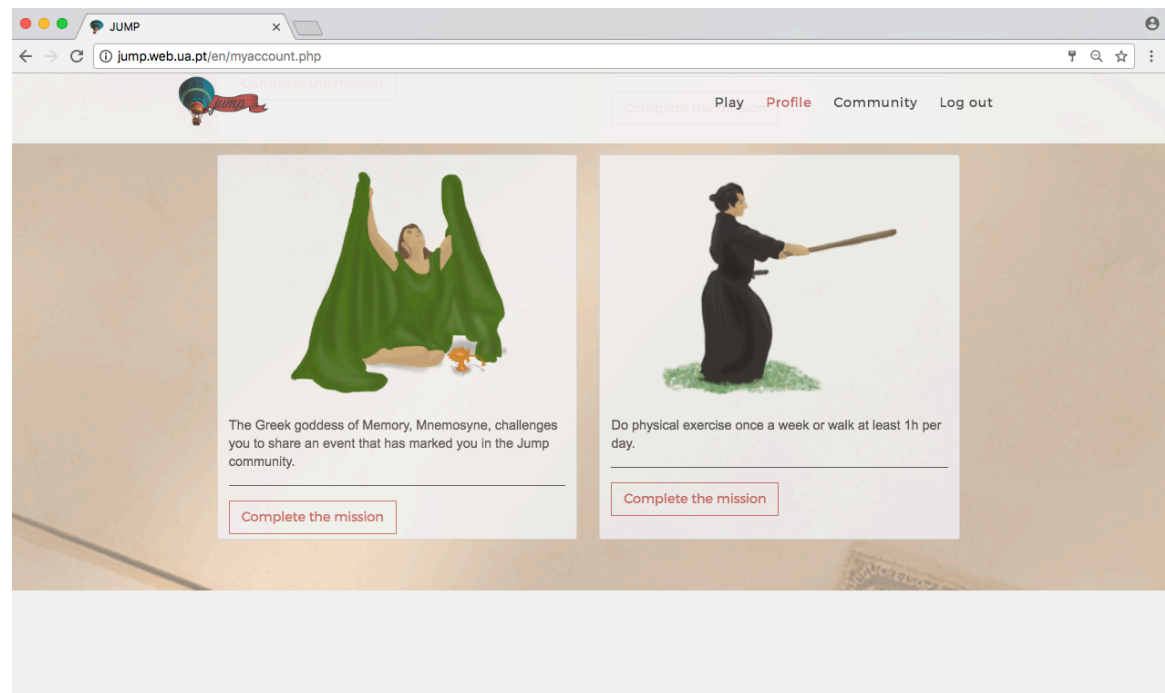
Figure 26: Mission screen (Screenshots)

Before the gameplay and each mini game, visual novels are presented as cut scenes (Figure 27) and the way to advance in the narrative can be either through a click or key pressing. These cut scenes were implemented by using the interactive storytelling Unity3D extension Fungus.

In terms of the gameplay, when players choose 'Paris, 1948' (Figure 28), missions related with Human Security and Human Rights are introduced. This era was chosen in order to create awareness of the role of institutions in Human Rights, through the use of history-related symbols (e.g. *Palais de Chaillot*, *Eleanor Roosevelt*) and history-related narratives. The game setting was in accordance with the place and date when the Universal Declaration of Human Rights was adopted.

Figure 27: Example of a game cutscene

The different types of threats to Human Security mentioned in Chapter 1 are covered in a Word Soup (Figure 29) whereas the Human Rights (Figure 30) are used in a Quiz, aiming at encouraging the search for information and fostering the players' attention to Human Rights.

Figure 28: Paris, 1948 (Palais de Chaillot)
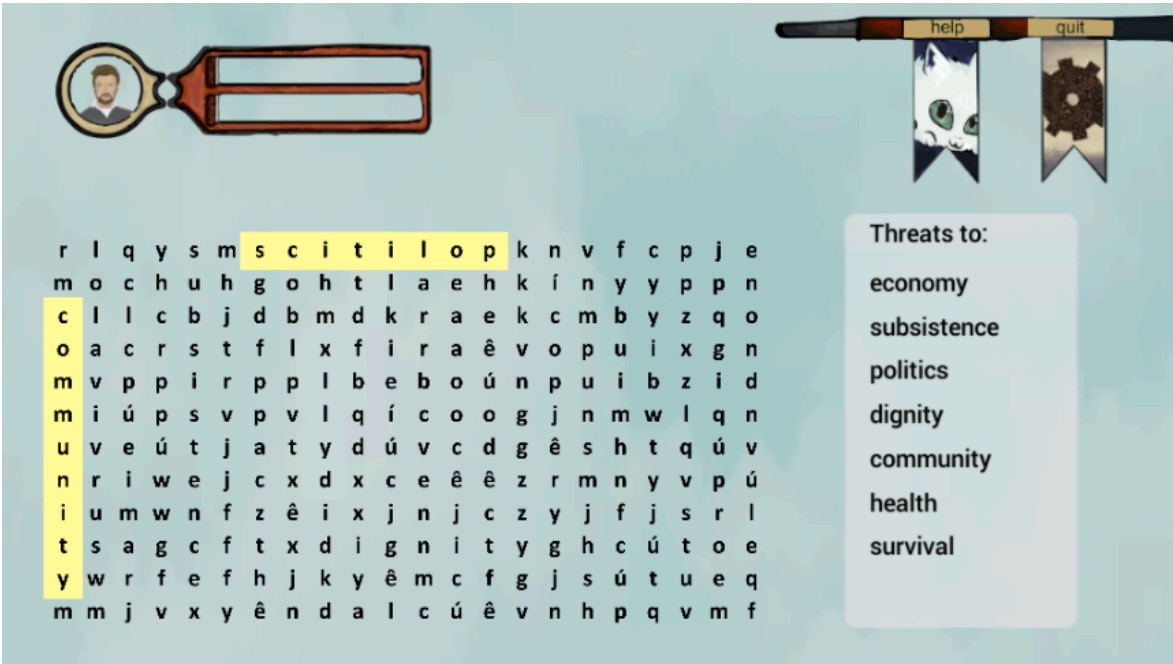
Figure 29: Paris, 1948 (Mini-games)

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Figure 30: Paris, 1948 (Mini-games)

The design of the game-based learning programme took into account the following recommendations: (a) encourage the participants to act upon their environment and political decisions (specially relative to Human Rights); (b) foster cognitive challenges (improve cognitive capacity); (c) present multimodal texts and schemas that illustrate the learning content; (d) connect the learning content and goals to daily activities; (e) enable the participants to contribute with their own content to the course; and (f) provide information about the source of information.

The mini games were developed using C# as programming language and Unity 3D editor. In terms of the game characters, the following factors were taken into account (Cheong, Jung, & Theng, 2011; Isbister, 2006):

- Anthropomorphism: distinction between human and non-human figures;
- Androgyny: gender distinction;
- Credibility: similarity with reality;
- Homophily: capacity to associate bonds with the game character either because of its appearance, motivation or actions.

The identification of these factors was important in order to foster similarity with reality since there is a preference manifested by the target audience for elements that are similar to

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the ones observed in the physical space rather than those that require some level of abstraction or that are different from the physical world (e.g. lack of gravity, changes in scale…) (Costa & Veloso, 2016b).

Figure 31 shows the characters of the game 'JUMP' and three of them (Thomas Allinson, Edith Margaret and Yamamoto Tsunetomo) are based on history:

- *Thomas Richard Allinson:* He was a dietetic and doctor in Britain, who encouraged people to have a good diet, do exercise and bathing instead of merely consuming medicines. Because of his theories of 'Hygienic Medicine', he was treated with some certain disbelief by other doctors and Medical Organizations

- *Edith Margaret Garrud:* She was a professional martial arts instructor of 'Jujutsu' and a couple of defence techniques. She also seems to have contributed to many charitable causes throughout her life.

- *Yamamoto Tsunetomo:* He was a Samurai in the Hizen Province and his practical and spiritual advices on how to be a Samurai warrior were later published in the book 'Hagakure';

Figure 31: Game characters

(Sul, Nubel, Seller, Thomas Allinson, Edith Margaret, Yamamoto Tsunetomo, Atlas, David)

The 2D game characters (Figure 31) and cut-scenes were designed using Photoshop whereas the three-dimensional version of the non-player characters (Seller, Thomas Allinson, Yamamoto Tsunetomo) and the avatar Sul were designed *Autodesk Character Generator* (Figure 32). The animation of the characters was defined using *Mixamo 3D Character Animation* and some of the clothes of the game characters were designed using the software *Marvelous Designer* (Figure 33). Many of the materials were the Standard of Unity and then designed in *Photoshop*, the 3D environments were created using Cinema 4D and finally, the voices were recorded and edited using Adobe Audition.
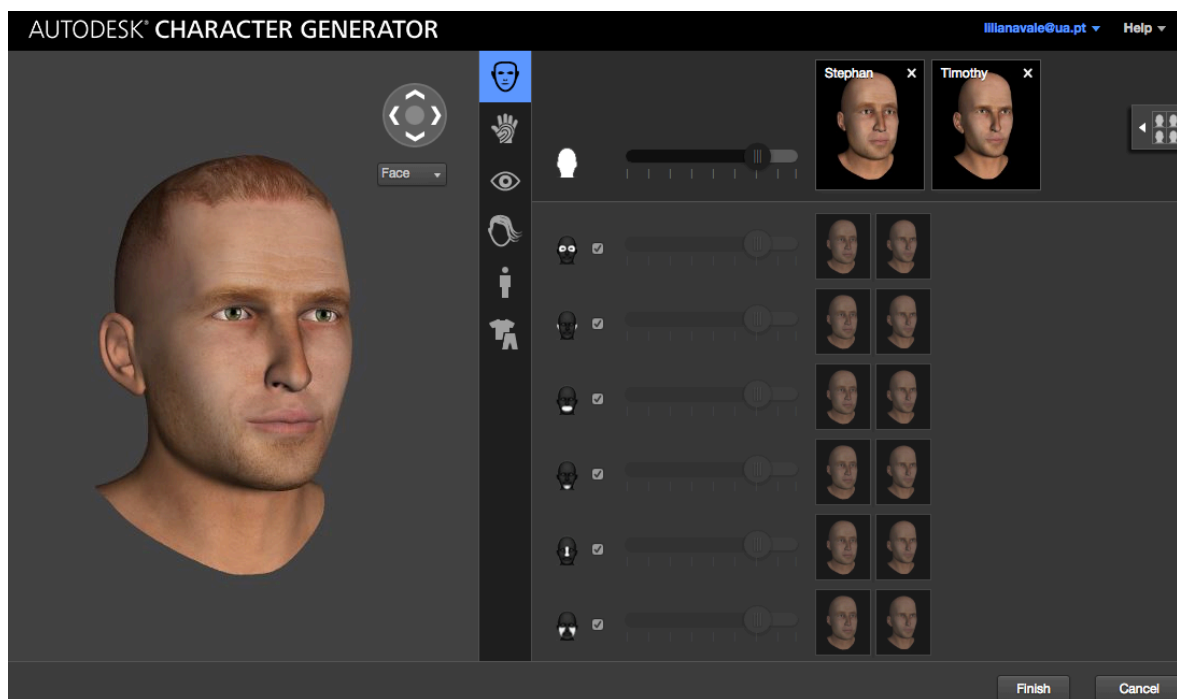
Figure 32: Designing the Seller using Autodesk Character Generator

In Hizen, 1709 (Figure 34), missions related to Physical and Cognitive activity are introduced. This era and narrative were chosen in order to discuss the importance of controlling the body and the mind through the art of being a Samurai. The mini games used had the purpose of training strategy (Figure 35) and simulating physical exercises (Figure 36). These mini games had different levels in order to get the player acquainted with the challenge and then foster a 'discover-it-yourself' attitude. The discourse used in the game is also aligned with the end users' main motivations to play: 'Prevent health problems.'

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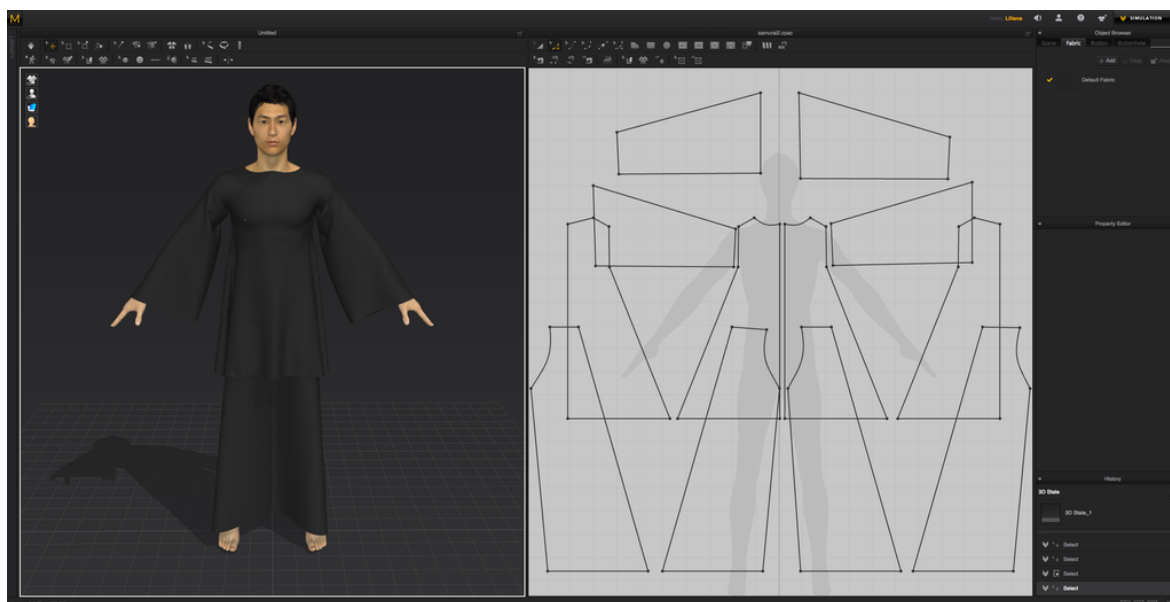
*Figure 33: Designing the clothes of Yamamoto Tsunetomo using Marvelous Designer*

Figure 34: Hizen, 1709 (Hizen Torii)

Figure 35: Minigame - Training Strategy

Figure 36: Minigame – Simulate physical exrcises

The development of this game scenario took into account the following recommendations: (a) foster cognitive challenges (training strategy); (b) foster self-discovery ('discover-it-yourself' attitude'); (d) present multimodal texts and schemas that illustrate the learning content; (e) include breathing exercises beyond agility and balance

exercise; and (f) simulate exercises to practice; and (g) present different types of diets and how the individuals' diet can be influenced by external factors (information about these diets).

Finally, London 1895 introduces a set of missions related to Nutrition and Participation in Society. This era and narrative was chosen in order to experience some scenarios of malnutrition and violation of basic human rights. This level embodies the following mini games:

- Get medicines to overcome the lack of nutrients (mini-game) (Figure 37): Sul has to talk with Thomas Richard Allinson about the reasons of malnutrition in poor children, who work in the factories. The main goal is to find food rich in a certain vitamin, aiming at producing the best medicines to 'help in vision and cell growth', 'function of the nervous system, blood, muscles and heart', 'prevent cataracts and relieve eye strain', 'repair ADN', 'help to alleviate anxiety and depression', among other scenarios.

- Remain unnoticed in the factory of Mr. Atlas and rescue a group of children from labour work. Sul has to find a uniform in order to be unnoticed in the factory. The uniform is in a container mixed with other false containers. In the false containers, there are the bacteria of the deadliest diseases in that age – tuberculosis, cholera and tifo. The main objective is to remember where the container with the uniform is when the containers shuffle.

In this game scenario, the following recommendations were taken into account: (a) inform the participants about macro- and micro-nutrients (mini game-nutrients); (b) draw the participants' attention to drink water daily (progress bar dependent on the number of cups of water drunk); (c) provide information about the nutrients of certain types of food; and (d) connect the learning content and goals to daily activities (*e.g.* food that contain certain vitamin); and (e) simulate a real scenario in which basic human rights were violated and educate for human dignity and rights (*e.g.* mini game – Factory of Mr.Atlas).

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Figure 37: Minigame - Nutrients

In general, these were some of the design decisions taken to implement the game: (a) The goal of the game is presented in a straightforward way (Action-oriented verbs) (Fonseca, Amado, & Costa, 2014); (b) The rewards to achieve with the accomplishment of the game missions are presented and quantified (e.g. win 50 experience points); (c) The game narrative is based on history facts (e.g. Paris, 1948 – Universal Declaration of Human Rights) (Costa & Veloso, 2016a); (d) Adopt a *player-versus-environment* (PvE) instead of a *player-versus-player* (PvP) game conflict (Veloso & Costa, 2015); (e) incorporate memory, attention and problem-solving mini games (Costa & Veloso, 2016b; Nap, De Kort, & IJsselsteijn, 2009); and (e) take into account such recommendations as avoiding challenges that depend on reaction time or speed; incorporating subtitles and establishing a minimum size for game elements (Costa, 2013; Fisk et al., 2009).

Development of the the Computer-Assisted Learning Programme (CALP)

In this section, the design and implementation of the Computer-Assisted Learning Programme[34] is described. Based on previous co-design sessions, the following requirements were defined in order to design and implement the Computer-Assisted Learning Programme: (a) develop an audio-visual strategy that both triggers narrative

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[34] SeriousGiggle (Portuguese version): http://seriousgiggle.web.ua.pt/ (Access date: Nov 5th, 2017)

immersion and at the same time make the learner familiar with the source of information (mentor's credibility); (b) foster self-knowledge ("know thyself"); (c) reward task-management; and (d) build a community of practice. Hence, the learning platform was divided into the following areas: *Learning*; *Rewards/Analytics*; *Learning Plan* and *Social*. For each area, different types of data were stored relative to the learner, the courses (tasks, subjects, exercises, videos), trophies, events and social activities (posts and topics). Figure 38 shows the database diagram, in which the following entities were covered and related data were stored.

As can be seen in Figure 38, the following are the activities that learners can do: schedule their learning events (*Learning Plan)*; share their views on the learning content (*Social*); be awarded by tasks and exercises performed (*Reward/Analytics*); and enrol in courses and different subjects and watch videos related with the content and share doubts relative to a certain minute of the video (*Learning*). The database entails the following elements:

- *Learner:* Information relative to the name, registration date, email, password, photo and description are stored;

- *Events:* The participants can create multiple events by inserting the title, start and end dates and add a description of the event;

- *Categories, Topic and Posts:* The participants can insert posts that dependent on the learning course. These posts are organized by categories (name, description, photo and time) and topics (subject, description, date, the participant who added the topic and files);

- *Trophy:* The participants can win trophies depending on the videos seen and the exercises completed;

- *Course:* The participants can enrol different courses (course name, course goals, course description, registration date, picture, course video, course instructor, and instructor photo);

- *Task:* Each course has many tasks that are completed when each video has been seen (course_courseId, video_videoId);

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- *Subjects, Video, Exercises:* Each course has many subjects (SubjectName, course_courseId) and each subject can have multiple videos (videoId, subtitle, subjects_subjectId, videopath, and videoName) and exercises (exerciseId, exerciseAnswer, subjects_subjectId, exerciseSolution); and

- *Doubts:* For each video, the participant can pose doubts at different timepoints of a video (learner_learnerId, video_videoId, doubtId, doubtText, doubtTime, doubtAnswer, doubtImage, doubtAnswerImage).

Relative to the architecture system (Figure 39), it is based on two areas: client-side (visible area to the user) and server-side (where the database is). The user has access to the system through a browser and they type the url and data about the login session (user and password).

The learning platform was built using *Bootstrap 3 Html*, *CSS* and *JavaScript framework*, *MySQL* and *PHP*. When the url is inserted in the page, there is a http request of the page from the client-side and the *html, css, javascript* and database content is returned through http response (Figure 39).

There are three user profiles: non-registered user, registered user and administrator:

- The non-registered user can access to the homepage that informs the user about the purpose of the learning platform and project and to the page 'How it works' that explains the main steps for interacting with the platform.

- The registered user can access to the profile area, enrol in courses, watch the lessons and pose doubts, check progress, schedule main events and both introduce and reply to topics of discussion.

- The administrator can manage the inserted content and registered users (responsible for the creation, reading, updating and deleting content – CRUD).
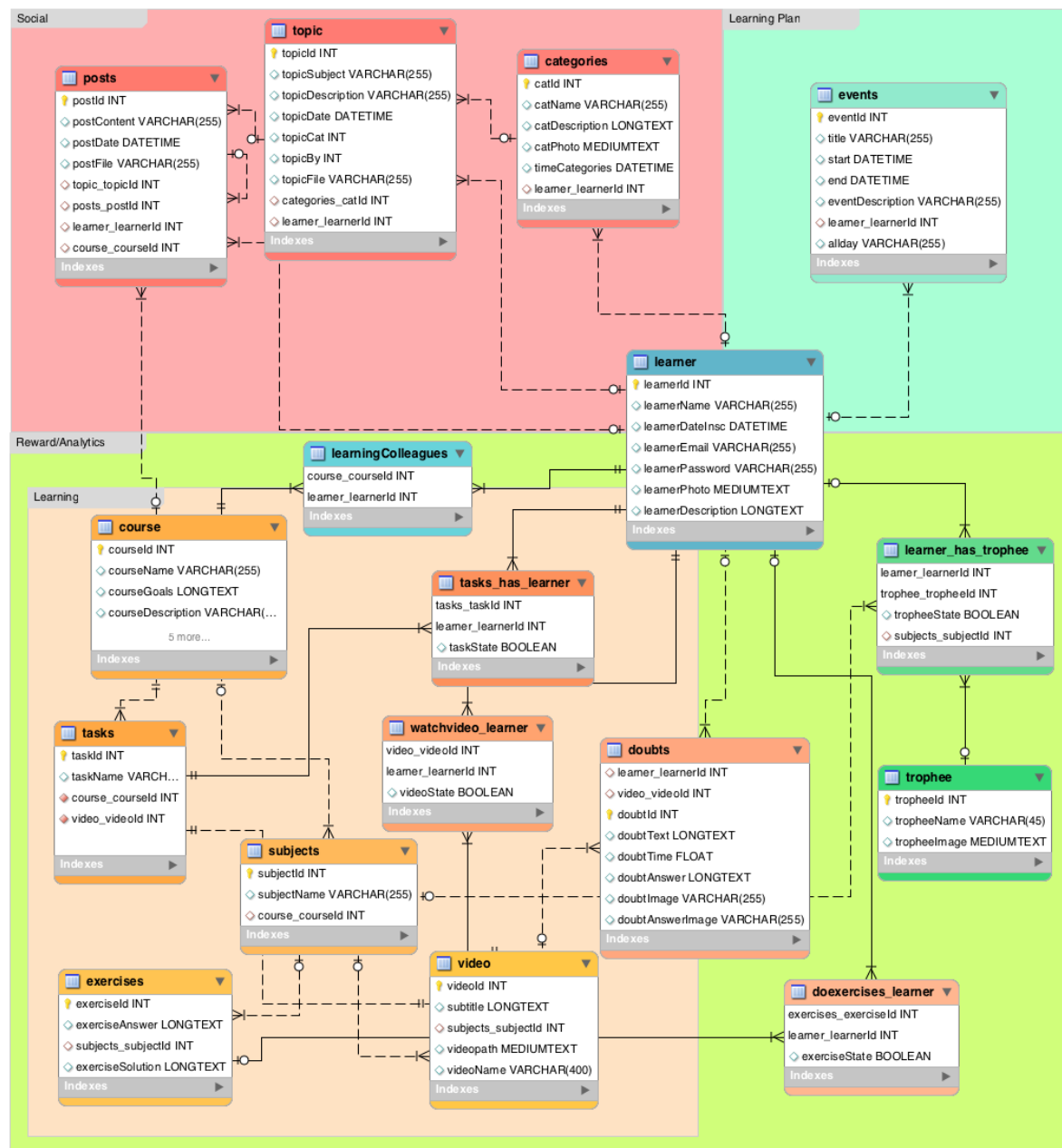
Figure 38: Database diagram
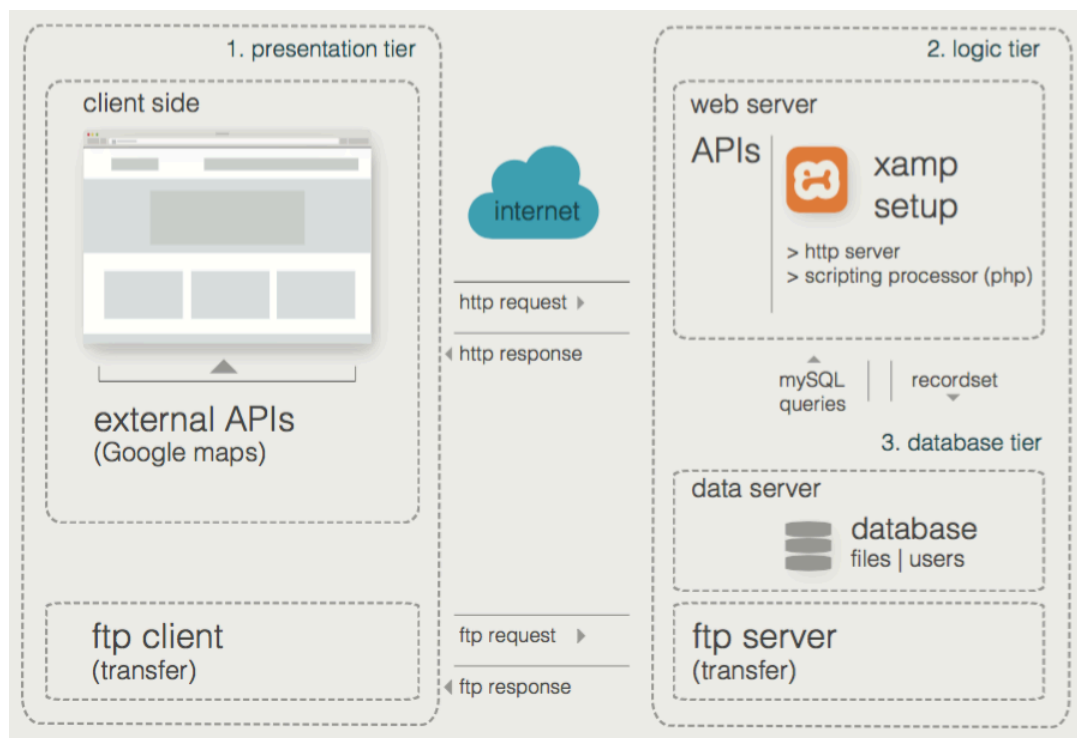
Figure 39: Architecture system

After defining the different areas of the Computer-Assisted Learning Programme[35], the *mock-ups* were designed – Information; Learning, Sharing and Exercises; and Events and Rewards. These areas are consistent with the functionalities pre-defined by the users: an identity profile area, on-demand delivery of video-based content, learning events, progress monitoring and rewards, communication and shareable information. Each module has a set of tasks to be accomplished by learners and as soon as this is achieved, the number of tasks decreases, badges can be collected and the percentage of progression increases.

During the development of the programme, the following recommendations were taken into account: (a) present multimodal texts and schemas that illustrate the learning content; (b) enable the participants to schedule their activities (calendar area); and (c) monitor the participants' progress and reward their activity (badges, progress bars); (d) organise the learning content in terms of goals/missions (task-management area); and (e) provide information about the source of information (information about the monitor).

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[35] The Computer-Assisted Learning Programme and all included materials have been developed by the researcher.

In order to identify the best audio-visual strategy for the online course, participants were asked to express their own opinions. They were given a set of options that were explained and examples were provided, in which participants had to choose the best and explain the reason. The options were: *Whiteboard animation* (telling a story by drawing on a white board), *Picture in Picture* (displaying two simultaneous videos), *Video-recorded lessons* (classes are recorded and distributed in video format) and *Audible Slides* (static images and text narrated by the instructor). Although the *Whiteboard animation* seems to be both the most appellative, and the one that grabs attention to the story being told, when presenting the course objectives and what the course is about, a video-recorded lesson should be used as the whiteboard animation misses the visual cue and "first impression" with the mentor of the course (the source of information).

Furthermore, when trying to use *YouTube*, many participants pointed out that videos should stop when they had a doubt about what was being referred. Therefore, the online programme (Figure 40) was designed to stop the video when the participants clicked on the button 'I have a doubt' and send not only the doubt to the instructor but also the timing of the video relative to the doubt of the learner.
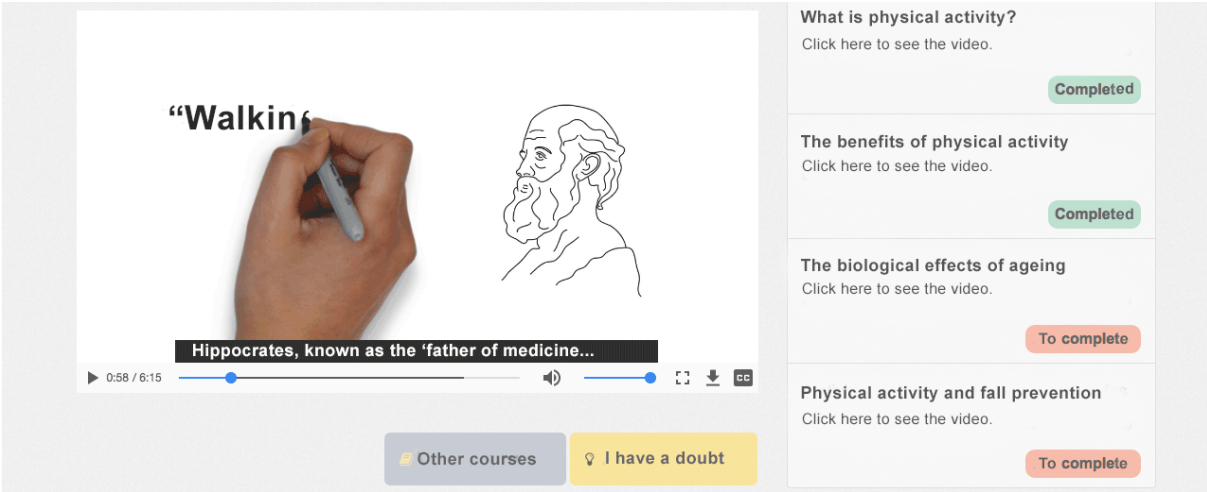
Figure 40. Video of the online course

There was also a need to engage learners and involve them into role-playing, aimed at fostering changes in behaviours. Therefore, a profile area was created to enable learners to create their own identity (Figure 41) (profile image, description, general progress, enrolled

modules, learning team ordered by their progression in the course) and be rewarded by self-management activities (Figure 42). This area aims to 'mirror' the current context of the University of Third Age ("myself and my own interests", "the tutor/learning colleagues and their interest", "my progression and others' progression", and "the subjects that I have been enrolled").
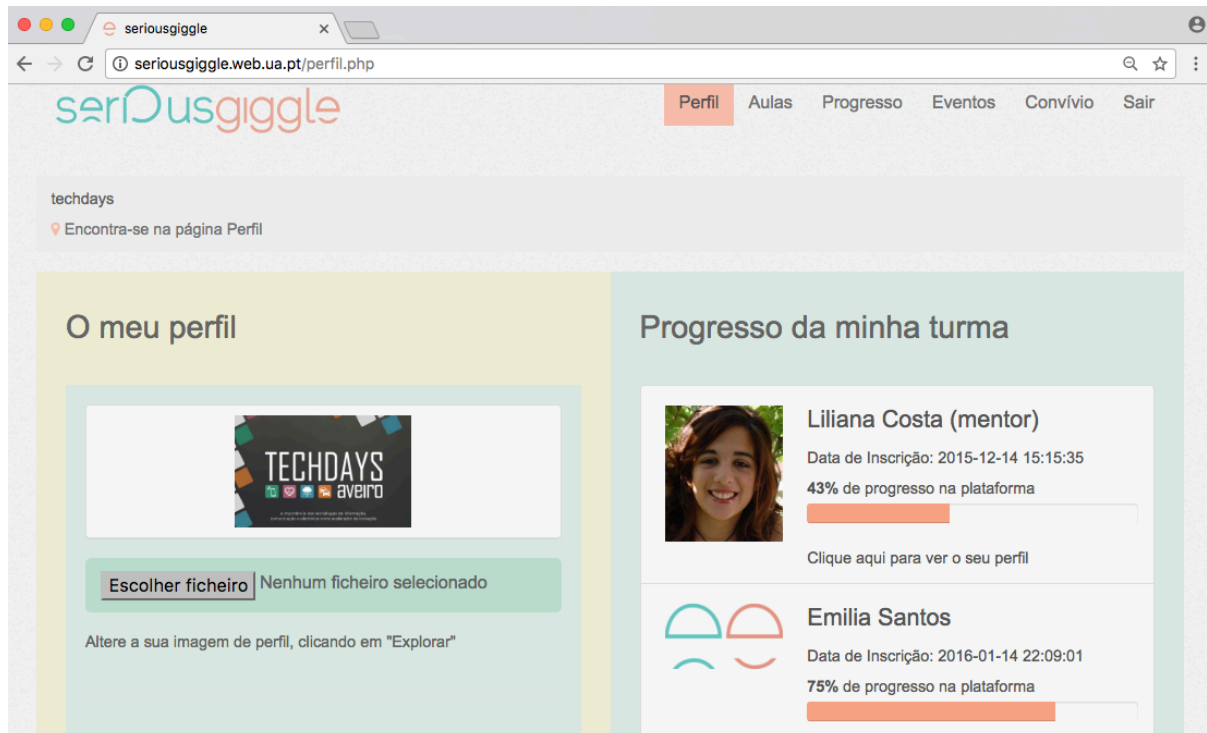
Figure 41. Profile area (Portuguese)

The learners could enrol in the following courses: Physical Activity, Nutrition, Cognitive Activity, Security and Participation in Society. These courses are in accordance with the main domains of Active Ageing provided by the World Health Organisation (2002), as mentioned previously in the Chapter 1 (p. 24).

For the 'Physical Activity', the following subjects were covered: The concept; Benefits; The biological effects of the ageing process; and Physical activity and Fall prevention. In this subject, the recommendations for its design followed were: simulate exercises to practice; enable the participants to schedule physical exercises; and include breathing exercises beyond agility and balance exercises.

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Figure 42. Learning Progress (Portuguese)

Relative to 'Nutrition', the following subjects were covered: Factors that influence nutrition; Diets: Mediterranean diet, Asian diet and vegetarianism; Human Nutrition: Macronutrients and Micronutrients; Food and Nutrition: Real and Conceptual differences; and Consequences of malnutrition. The recommendations followed for the design of this subject were: (a) present different types of diets and how the individuals' diet can be influenced by external factors; and (b) provide information about the nutrients of certain types of food.

The course 'Cognitive Activity' addresses the following subjects: The brain and the ageing process; The brain functioning: The mechanisms of sensation, perception and attention; Memory and the learning process. The recommendations followed for the design of this subject were: (a) connect the learning content and goals to daily activities.

In terms of 'Security' and 'Participation in Society', these were the subjects: Concept of Human Security, Types of human security, The rights of the older adults; Human development and Social Intervention policies; Intervention policies in the environment; and Intervention policies in Education. The recommendations followed for the design of this subject were: (a) give the possibility of using the learning programme at home but

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assist the adult learner outdoors; (b) encourage the participants to act upon their environment and political decisions;

Finally, each subject had a set of tasks to be accomplished by learners and as soon as the participants completed them, the number of tasks decreased, badges could be achieved and the percentage of progression was increased. Furthermore, there was also an area in which learners could create learning events and a communication area in which learners discussed the learning content with their colleagues.

6.1.2 PHASE 2: The Quantitative Experimental Research

In order to assess the psychosocial variables that game designers should take into account when designing and assessing games for active ageing, repeated ANOVA[36] tests were used.

Given the hypotheses formulated in the Introduction, the null hypothesis is not rejected. Thus, "*H_0: There were no significant differences between the type of the experiment undertaken by each group (G1, G2 or G3) and their perception on wellbeing and quality of life.*"

Although no significant differences between the type of experiment undertaken by each group and their perception of wellbeing and quality of life were found, there were significant differences between the group type and their perception on mental health ($F_{(2,57)} = 3.771$, p=.029) and general health-related wellbeing ($F_{(2,57)} = 5.231$, p=.008), in which the game experiment showed improvements relative to the computer-assisted learning programme. These differences can be also observed, using descriptive statistics (Table 26, Table 27 and Table 28).

In terms of the Mental Health domain (D8-MH), an increase has been observed from the Baseline (M = 51.77, SD =6.93) to the Midpoint (M = 52.27, SD =7.52) in the Experimental Group (G1) (Table 26) and from the Midpoint (M = 48.92, SD =9.11) to the Post-test (M = 49.79, SD =8.18) in the Comparison Group (G2) (Table 27) [When these groups tested the game]. These values almost remained constant in the Control Group (G3) (Table 28).

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36 The ANOVA test was used in order to determine whether there was any statiscally significant difference between the means of the three groups (G1, G2 and G3).

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Table 26. Participants' assessment of health-related wellbeing and quality of life (Experimental Group- G1)

Experimental Group (G1) (Independent Variable)

Dependent variables	Baseline M	Baseline SD	Midpoint M	Midpoint SD	Midpoint t	Post-test M	Post-test SD	Post-test t
SF36v2								
D1- PF	48.92	9.06	50.46	6.99	-1.13	50.65	6.14	-.467
D2- RP	50.52	8.36	49.97	7.52	.470	50.33	7.38	-.615
D3- BP	48.53	7.91	48.23	9.33	.301	48.39	9.58	-.211
D4- GH	47.67	6.05	47.29	6.87	.255	47.74	6.22	-.417
D5- Vitality	55.54	9.05	53.49	10.41	1.14	54.04	10.24	-1.16
D6- SF	51.79	6.42	51.79	6.61	.001	51.79	6.41	.000
D7- RE	46.29	11.25	45.91	9.79	.224	46.67	10.89	-.678
D8- MH	51.77	6.93	52.27	7.52	-.317	50.78	8.94	1.27
PHTotalScore	49.13	7.12	49.40	7.07	-.385	49.79	5.71	-.732
MTotalScore	51.40	8.48	50.75	8.33	.446	50.40	9.18	.343
SF6D (Utility Index Score)	.753	.125	.754	.119	-.072	.729	.136	.578
SF6D (Utility Index Score 2)	.735	.114	.734	.108	.052	.744	.147	.303
WHOQOL-BREF								
D1-PH-QoL	75.89	15.92	78.21	17.07	-1.89	76.61	18.41	.91
D2-P-QoL	73.13	13.28	78.75	14.80	-4.24**	75.83	16.09	1.56
D3-SR-QoL	60.41	20.75	67.08	15.64	-1.67	63.75	18.98	1.17
D4 – E-QoL	67.66	14.98	71.41	14.38	-2.94**	70.47	13.88	.74

SF36v2 D1-PF: Domain1 - Physical Functioning; D2-RP: Domain1 - Role-Physical; D3-BP: Domain3 - Bodily Pain; D4-GH: Domain4 – General Health; D5-Vitality: Domain5 – Vitality; D6-SF: Domain6 – Social Functioning; D7-RE: Domain7 – Role-Emotional; D8-MH: Domain8 – Mental Health; PHTotalScore: Physical Health Total Score; MTotalScore: Mental Health Total Score; WHOQOL-BREF D1-PH-QoL: Domain1 - Physical Domain; D2-P-QoL: Domain2 – Psychological Domain; D3-SR-QoL: Domain3– Social Relationships Domain; D4-E-QoL: Domain4– Environment Domain; ** $p<0.01$; [M] t: paired samples t test results

In regards to General Health-related wellbeing, although there was a slightly decrease from the baseline period (M = 47.67, SD =6.05) to the midpoint (M = 47.29, SD =6.87) in the Experimental Group (G1) (Table 26), there was an increase of the values from the Midpoint (M = 45.89, SD =8.16) to Post-test (M = 48.91, SD =7.63) in the Comparison Group (G2) (Table 27). The Control Group has experienced a slightly decrease in the values of this domain throughout this period (Table 28).

Regarding the Quality of Life, the Psychological domain (P-QoL) domain increased significantly from the Baseline (M = 73.13, SD =13.28) to Midpoint (M = 78.75, SD = 14.8) (t (19) = -4.24, p<= 0.01, r =.92) in the Experimental Group. In the same vein, the Environment domain (E-QoL) also increased from the Baseline (M = 67.66, SD =14.98) to Midpoint (M = 71.41, SD = 14.4) (t(19) = -2.94, p<= 0.01, r =.93) (Table 26).

Table 27. Participants' assessment of health-related wellbeing and quality of life (Comparison Group – G2)

Comparison Group (G2) (Independent Variable)

Dependent variables	Baseline		Midpoint			Post-test		
	M	SD	M	SD	t	M	SD	t
SF36v2								
D1- PF	49.39	6.99	48.05	7.34	1.10	48.63	7.14	-.448
D2- RP	46.77	7.69	46.22	8.47	.553	47.68	6.83	-1.16
D3- BP	46.99	7.84	45.83	10.65	.755	45.59	9.73	.147
D4- GH	47.41	7.62	45.89	8.16	1.09	48.91	7.63	-2.68
D5- Vitality	54.18	6.39	52.55	8.91	1.11	52.68	9.19	-.119
D6- SF	49.57	7.26	48.34	8.03	1.00	49.57	7.76	-.921
D7- RE	45.52	8.51	44.76	10.23	.404	45.14	10.05	-.186
D8- MH	49.04	7.56	48.92	9.11	.098	49.79	8.18	-.850
PHTotalScore	48.20	7.15	46.82	7.98	1.26	47.90	7.23	-.999
MTotalScore	49.33	7.76	48.74	10.34	.385	49.38	10.14	-.460
SF6D (Utility Index Score)	.726	.133	.689	.127	2.11	.685	.121	-1.76
SF6D (Utility Index Score 2)	.718	.124	.685	.121	2.09	.709	.124	-1.62
WHOQOL-BREF								
D1-PH-QoL	70.71	13.34	71.25	12.6	-.35	68.75	14.65	1.49
D2-P-QoL	70.63	8.71	71.25	10.2	-.77	71.67	16.09	1.56
D3-SR-QoL	56.25	18.71	55.42	18.59	.623	59.58	18.98	1.17
D4 – E-QoL	68.59	13.73	68.75	14.23	-.08	67.81	11.20	.552

SF36v2 D1-PF: Domain1 - Physical Functioning; D2-RP: Domain1 - Role-Physical; D3-BP: Domain3 - Bodily Pain; D4-GH: Domain4 – General Health; D5-Vitality: Domain5 – Vitality; D6-SF: Domain6 – Social Functioning; D7-RE: Domain7 – Role-Emotional; D8-MH: Domain8 – Mental Health; PHTotalScore: Physical Health Total Score; MTotalScore: Mental Health Total Score; WHOQOL-BREF D1-PH-QoL: Domain1 - Physical Domain; D2-P-QoL: Domain2 – Psychological Domain; D3-SR-QoL: Domain3– Social Relationships Domain; D4-E-QoL: Domain4– Environment Domain; ** p<0.01; M t: paired samples t test results

Table 28. Participants' assessment of health-related wellbeing and quality of life (Control Group – G3)

Control Group (G3) (Independent Variable)

Dependent variables	Baseline		Midpoint			Post-test		
	M	SD	M	SD	t	M	SD	t
SF36v2								
D1- PF	46.69	8.54	45.16	8.75	.984	45.45	9.68	-.171
D2- RP	43.58	8.93	42.69	9.11	.391	43.25	10.0	-.347
D3- BP	40.97	10.53	40.01	9.16	.463	40.36	9.83	-.299
D4- GH	44.47	8.50	43.63	7.02	.625	43.99	8.22	-.363
D5- Vitality	50.24	7.47	48.87	7.67	.830	49.69	8.57	-.547
D6- SF	44.88	10.19	43.64	8.22	.705	46.46	7.50	-1.76
D7- RE	40.37	9.75	38.27	9.22	.923	39.61	8.81	-1.05
D8- MH	44.84	10.21	45.08	7.66	-.169	45.63	7.72	-.795
PHTotalScore	45.13	8.59	43.97	8.87	.621	44.13	10.31	-.096
MTotalScore	44.50	9.70	43.63	6.49	.520	45.20	6.89	-1.87
SF6D (Utility Index Score)	.6455	.120	.626	.082	.718	.633	.100	-.416
SF6D (Utility Index Score 2)	.639	.107	.625	.077	.642	.632	.090	-.553
WHOQOL-BREF								
D1-PH-QoL	63.93	20.27	59.64	19.94	1.85	63.57	21.35	-1.54
D2-P-QoL	69.58	10.57	72.50	10.51	-1.97	72.50	11.74	.00
D3-SR-QoL	60.00	17.65	62.08	17.62	-1.75	60.83	17.54	1.00
D4 – E-QoL	68.44	13.22	68.12	12.10	.216	68.91	12.06	.552

SF36v2 D1-PF: Domain1 - Physical Functioning; D2-RP: Domain1 - Role-Physical; D3-BP: Domain3 - Bodily Pain; D4-GH: Domain4 – General Health; D5-Vitality: Domain5 – Vitality; D6-SF: Domain6 – Social Functioning; D7-RE: Domain7 – Role-Emotional; D8-MH: Domain8 – Mental Health; PHTotalScore: Physical Health Total Score; MTotalScore: Mental Health Total Score; WHOQOL-BREF D1-PH-QoL: Domain1 - Physical Domain; D2-P-QoL: Domain2 – Psychological Domain; D3-SR-QoL: Domain3– Social Relationships Domain; D4-E-QoL: Domain4– Environment Domain; [**] p<0.01 t: paired samples t test results

However, the same variances in the Psychological and Environment domains in the Comparison Group (G2) (Table 27) and Control Group (G3) (Table 28) were not verified.

As was mentioned in Chapter 5, the first group of participants to be assessed in terms of the use of platforms were also asked to share their opinions on the way that these could affect active ageing. The following topics have emerged during the discussion:

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Confidence to solve Daily Problems; Motivation to Participate in the Community; Decrease in Ageing Bias; and Find Solutions to Problems.

Then, all participants from the Experimental Group (G1) and Comparison Group (G2) were asked to rate their experience, using a scale from 0 (0=Never) to 4 (4=Always) and Pearson's correlations[37] between the different domains of health-related wellbeing and quality of life and these recommendations were then performed.

Table 29, 30 and 31 show the domains of quality of life and health-related wellbeing to be taken into account when designing a game-based learning programme.

In terms of quality of life (Table 29), the environment domain seems to be correlated with the participants' Confidence to solve Daily Problems (G1: $r=.514$, $p=.02$; G2: $r=.489$, $p=.03$), Motivation to Participate in Society (G1: $r=.554$, $p=.01$), Decrease in Ageing Bias (G2: $r=-.678$, $p< .01$), and Finding solutions to Problems (G2: $r=.509$, $p=.02$). The psychological domain seems to be correlated with the Decrease in Ageing Bias (G2: $r=-.49$, $p=0.03$).

In regards to health-related wellbeing (Tables 30 and 31), the mental health domain seems to be correlated with the confidence to solve daily problems (G2: $r=.524$, $p=.02$) and motivation to participate in the community (G2: $r=.583$, $p< .01$). In addition, the general health, vitality and social functioning seem to be correlated with the participants' confidence to solve daily problems (G2: $r=.59$, $p< .01$; $r=.624$, $p< .01$; $r=.481$, $p= .03$) and motivation to participate in the community (G2: $r=.79$, $p< .01$; $r=.49$, $p= .03$; $r=.476$, $p= .03$). Finally, the role-functioning also seems to be correlated with the decrease in ageing bias ($r=-4.73$, $p=.04$).

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[37] Pearson's correlations test was used in order to understand the degree of relationship between each domain of SF36v2 and WHOQOL-BREF (independent variable) to Confidence to solve daily problems, Motivation to Participate in the Community; Decrease in Ageing Bias, and Find Solutions to Problems (dependent variables)

Table 29. Correlation between the WHOQOL-BREF and identified variables relative to the prototypes

(after the Game-based Learning Experiment)

Experiment: Game-Based Learning Programme (GBLP)

	Experimental Group (G1)				Group of Comparison (G2)			
	D1-PH-QoL	D2-P-QoL	D3-SR-QoL	D4 – E-QoL	D1-PH-QoL	D2-P-QoL	D3-SR-QoL	D4 – E-QoL
Cf-D	$r=.341$	$r=.355$	$r=.142$	$r=.514*$	$r=.429$	$r=.335$	$r=.088$	$r=.489*$
M-PC	$r=.285$	$r=.437$	$r=.242$	$r=.554*$	$r=.089$	$r=.319$	$r=.088$	$r=-.077$
D-AG	$r=-.268$	$r=-.250$	$r=-.140$	$r=-.204$	$r=-.368$	$r=-.49*$	$r=-.480*$	$r=-.678**$
F-SP	$r=.100$	$r=.135$	$r=-.128$	$r=.088$	$r=.339$	$r=.234$	$r=.173$	$r=.509*$

WHOQOL-BREF D1-PH-QoL: Domain1 - Physical Domain; D2-P-QoL: Domain2 – Psychological Domain; D3-SR-QoL: Domain3– Social Relationships Domain; D4-E-QoL: Domain4– Environment Domain; Cf-D: Confidence to Daily Problems; M-PC: Motivation to Participate in the Community; D-AG: Decrease in Ageing Bias; F-SP: Find Solutions to Problems [*]p<0.05 [**]p<0.01 *r:* Pearson's correlations test results

Table 30. Correlation between the SF36v2 and identified variables relative to the prototypes

(after the Game-based Learning Experiment)

Experiment: Game-Based Learning Programme (GBLP)

	Experimental Group (G1)							
	D1- PF	D2- RP	D3- BP	D4- GH	D5- VI	D6- SF	D7- RE	D8- MH
Cf-D	$r=.280$	$r=.233$	$r=.195$	$r=-.047$	$r=.279$	$r=.225$	$r=.219$	$r=.424$
M-PC	$r=.188$	$r=.070$	$r=.289$	$r=-.272$	$r=.121$	$r=.381$	$r=.349$	$r=.256$
D-AG	$r=-.145$	$r=.062$	$r=.171$	$r=-.148$	$r=.071$	$r=.090$	$r=.162$	$r=-.154$
F-SP	$r=-.155$	$r=-.017$	$r=-.255$	$r=-.002$	$r=-.02$	$r=.000$	$r=.033$	$r=.090$

SF36v2 D1-PF: Domain1 - Physical Functioning; D2-RP: Domain1 - Role-Physical; D3-BP: Domain3 - Bodily Pain; D4-GH: Domain4 – General Health; D5-Vitality: Domain5 – Vitality; D6-SF: Domain6 – Social Functioning; D7-RE: Domain7 – Role-Emotional; D8-MH: Domain8 – Mental Health; Cf-D: Confidence to Daily Problems; M-PC: Motivation to Participate in the Community; D-AG: Decrease in Ageing Bias; F-SP: Find Solutions to Problems [*]p<0.05 [**]p<0.01 *r:* Pearson's correlations test results

Table 31. Correlation between the SF36v2 and identified variables relative to the prototypes

(after the Game-based Learning Experiment)

Experiment: Game-Based Learning Programme (GBLP)

	Comparison Group (G2)							
	D1- PF	**D2- RP**	**D3- BP**	**D4- GH**	**D5- VI**	**D6- SF**	**D7- RE**	**D8- MH**
Cf-D	r=.219	r=.205	r=.399	r=-.59**	r=.624**	r=.481*	r=.411	r=.524*
M-PC	r=.087	r=.026	r=-.342	r=-.79**	r=.490*	r=.476*	r=.234	r=.583**
D-AG	r=-.426	r=-4.73*	r=-.105	r=.023	r=-.093	r=-.089	r=-.227	r=-.013
F-SP	r= .218	r=-.148	r= .008	r=-.159	r=-.050	r=-.028	r=-.041	r=-.220

SF36v2 D1-PF: Domain1 - Physical Functioning; D2-RP: Domain1 - Role-Physical; D3-BP: Domain3 - Bodily Pain; D4-GH: Domain4 – General Health; D5-Vitality: Domain5 – Vitality; D6-SF: Domain6 – Social Functioning; D7-RE: Domain7 – Role-Emotional; D8-MH: Domain8 – Mental Health; Cf-D: Confidence to Daily Problems; M-PC: Motivation to Participate in the Community; D-AG: Decrease in Ageing Bias; F-AG: Decrease in Ageing Bias; F-SP: Find Solutions to Problems [*] $p<0.05$ [**] $p<0.01$ *r:* Pearson's correlations test results

Overall, these were the health-related wellbeing and quality of life domains to be taken into account [38], when designing a game-based learning programme:

- *The Environment domain*

This domain seems to be important to affect the confidence to solve daily problems and the motivation to participate in society. It is also interrelated with the decrease in ageing bias and the capacity to find solutions to problems. As mentioned in Chapter 5 (p.148), this domain covers information about the participants' environmental context. Given the development of a Game-based Learning Programme for active ageing, one may suppose that the following requirements could serve as basis to design and assess the programme: *Does it provide information about health and social care*?; *Does it foster opportunities for acquiring new information and skills? Does it encourage the players to participate in in-door and outdoor recreation/leisure activities?*

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[38] Only the domains that were related to two or more than two variables were considered

- *The Mental Health domain*

This domain seems to be important to affect the confidence to solve daily problems and the motivation to participate in society. As mentioned in Chapter 5 (p.147), this domain covers information about the participants' mental health. Given the development of a game-based learning programme for active ageing, one may suppose that the following requirements could serve as basis to design and assess the programme: *Does it help the player to cope with their emotions?*; *Does it create awareness of the players' own behaviours and emotions, when (s)he playing the game?; Is there any sort of type of pleasure (e.g. physio-, socio-, psycho- or ideo-) (see Chapter 4, p.102) associated to the game-playing activity?*

- *The Social Functioning domain*

This domain seems to be important to affect the confidence to solve daily problems and the motivation to participate in society. As mentioned in Chapter 5 (p.147), this domain covers the impact of physical and emotional problems on social activities. Given the development of a game-based learning programme for active ageing, one may suppose that the following requirements could serve as basis to design and assess the programme: *Does it create empathy with the end-users towards health-related problems (e.g. homophily with game characters) (see Chapter 6, p.192)?; Does it encourage the discussion of the simulated scenarios in daily life? .*

- *Vitality domain*

This domain seems to be important to affect the confidence to solve daily problems and the motivation to participate in society. As mentioned in Chapter 5 (p.147), this domain covers the participants' energy level, fatigue and subjective wellbeing. Given the development of a game-based learning programme for active ageing, one may suppose that the following requirements could serve as basis to design and assess the programme: *Does it create moments of learning arousal to the user (i.e. balance the level of difficulty with the learners' ability – flow theory)?*

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- *General health domain*

This domain seems to be important to affect the confidence to solve daily problems and the motivation to participate in society. As mentioned in Chapter 5 (p.147), this domain covers the participants' overall perceived health status and expectations towards health. Given the development of a game-based learning programme for active ageing, one may suppose that the following requirements could serve as basis to design and assess the programme: *Does it encourage the player to adhere to health-related habits? Does it enable scaffolding though health-related activities (e.g. using the cycle change – see Chapter 1, p.21)?*

6.1.3 PHASE 3: The Mixed-Method Research

Given the design components of both learning programmes that were discussed in the PHASE 1 and the determinants of wellbeing and quality of life in the design of a Game-based Learning Programme (PHASE 2), there was a need to understand its interrelationship. Therefore, the feedback of the participants relative to the prototypes developed was collected and a set of interviews with Subject Matter Experts in the fields of Games/Human-Computer Interaction and Psychology/Marketing/Ageing Studies were carried out.

A. Cooperative evaluation of the prototypes with G1 and G2

Relative to the prototype testing, the participants' perspectives on the strengths and weaknesses of both prototypes (Game-based Learning and Computer-Assisted Learning Programme) were outlined.

Game-Based Learning Programme (GBLP)

Relative to the game, the participants liked the game graphics, narrative and found it easier to interact with the mouse cursor. The participants also stated that the game motivated them to act upon the information. The idea of traveling throughout time during the gameplay and the game music were seen as an added plus and the scenarios also

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enabled the participants to re-create sensory perception of different *stimuli* ('sense of being there'). For example, these were some of the participants' quotes:

> *"Wow, I'm impressed. The idea of traveling in time and exploring different cities and historical facts in a game was very good."*
>
> *"Thank God there is no need to use the keyboard in order to play the game. This is simple"*
>
> *"This music is very good. I like it very much."*
>
> *"This looks familiar… It is like I've been here […] When travelling to one place, it could link the information of the game with the historical archive from the past until now […]"*
>
> − Participants (University of Third Age)

In addition, strategy and memory mini-games were types of games that were well accepted by the subjects, as can be illustrated in the following participant's statement:

> *"I like these types of games: Word Soup, Sudoku, Word Games… and this game that you presented is the type of game that I'd play but as I use the computer only when I need it, I regret that I wouldn't even try […]"*
>
> − Participant (University of Third Age)

Finally, another aspect that the participants highlighted was the fact that they were very interested in checking the food that contained a certain type of vitamin and they were also motivated to repeat and progress in the game with the use of such immediate messages as 'Congratulations' and end-screens for each level with the points obtained.

As for the game weaknesses, I observed that the game processing was slow in some computers and there was difficulty in playing the strategy game 'Connecting the dots' in Hizen, 1709. Indeed, the information provided was neither clear nor provided in a timely manner. These were some of the participants' statements:

> *"What do I do now?"*
>
> *"How do I connect the symbols? I have clicked on the temples. Oh, I need to click on the symbols first. Ok, I get it. You can go."*

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"Before playing, I guess it is necessary to introduce the game. In other words, prepare us to the gameplay."

– Participants (University of Third Age)

Difficulties were also observed in the scenario of Paris, 1948 in which clickable areas were not distinguished from other elements of the scenario.

"Ok, I'm in Paris. What do I do now?"
"The man is weaving me. How do I approach him?"

– Participants (University of Third Age)

In addition, the mini games did not enable the players to retrieve the information at any time of the game-playing, forcing the player to replay in order to have access to that information. The exercises could also be more diversified with different difficult levels and bionotes should be provided. As one of the participants pointed out:

"Who is Sul? Who is Thomas Allinson? I need to be remembered of the story [...] Ok, it was presented in the beginning but I almost forgot: it was something about time travelling but it is all that I can remember though."

– Participants (University of Third Age)

The game could also have reinforced the interlink between the game challenges and the context (either indoors or outdoors):

"If the game could be incorporated in my daily life and entertain me during my trips and invite me going outside – that would be nice"
"[...] For example, a challenge that enables us to link the information that was given to us with our daily life."
"We could have done these and other exercises outside."

– Participants (University of Third Age)

In a nutshell, these were the main aspects that the end-users stated that the game could improve: (a) Reinforce the number of hints and tutorials; (b) Provide a way to retrieve

information without the need to replay the game; (c) Present the bios of the characters, history-related facts; and (d) Reinforce the link established between games and daily life activities.

Computer-Assisted Learning Programme (CALP)

According to the participants, the learning profile was very important and the progress bars motivated them to perform the activities. The participants also stated that the videos were simple and easier to understand, being informative and simple. For example, this fact can be illustrated in the following participants' statement:

> *"I think that these videos get my attention. Adding colour to the drawings would be more appellative, though."*

> – Participants (University of Third Age)

Furthermore, the video subtitles helped one of the participants, who had problems with the sound. The participants have also outlined that the functionality of marking doubts relative to a specific moment of the video encouraged them to associate a piece of information shared in a specific moment to the learning content and that the doubt of other users could also be their own doubts.

Relative to the progress area, most of the participants competed with their colleagues based on the ranking. Nevertheless, they stated that they would use the platform in order to obtain further information about a topic and not for the purpose of interacting with colleagues.

The profile area was also relevant as it interconnected the learning activity to the end-users' identity and the information retrieval was easier when interacting with the platform rather than with the game.

In terms of the weaknesses of the video-based learning and suggestions for improvement, some of the participants have expressed their concern towards some of the learning areas as it was a bit confusing to distinguish between their profile and colleagues' profile. In fact, the profile area showed too much information and the users' progress per module should be visible, instead of the overall progress. As one of the participants points out:

> *"Who are these people? I am not this guy. Where is my profile?"*

"I finished the module of Cognitive Activity and my progress is low in my profile […]"

"The same happened to me […] Ah, I think it should be per Module, then."

– Participants (University of Third Age)

Hence, it would be easier to display the contacts' information horizontally and distinguish the users' profile from friends.

The subjects also stated that video-based lessons should be interlinked with social media as their contacts could answer their doubts and interact with them within the platform. The exercises should be context-based, aiming at giving the opportunity to apply the knowledge obtained to the videos and reinforcing the link with social networks, locations and photos. These are some of their statements:

"Who will answer to my doubt? My friends on Facebook? But they can if I send it to them, right?"

"How do I share this on Facebook?"

"What about trying these different diets in a lunch/dinner meeting?"

– Participants (University of Third Age)

In addition, synchronisation between the images and sound should be improved:

"In some videos, the image goes faster than sound"

– Participant (University of Third Age)

Rewards and video feedback should also be improved. For example, feedback on whether the video has been watched and giving the option to watch it again or the next video should be provided. As the participants note:

"At the end of each video, present the information that the video has been watched and give the option to watch it again or watch the next video."

"Has this video already been finished? […] Where do I click to move to the next one?"

"It stopped. Shouldn't it reproduce the 5 videos?"

– Participants (University of Third Age)

Badges were not so appealing to the participants and a recommendation for incorporating them in the learning process would be through interactive videos (after task-based videos). In addition, other end-users' doubts could be embedded in the video as they could be a challenge to other users and, therefore, be awarded with points (community rating to validate the answers given).

"I think that it is very important to check our performance – if we learn the information that is given. For example, a challenge that enables us to link the information that was given to us with our daily life."

"I would like to see my grade and how well I did when compared with others [...] But how can I see what I was missing and in which areas I performed better in comparison with my colleagues?"

– Participants (University of Third Age)

The participants also stated that as soon as they registered in the platform, they should be able to enter (without having to login).

"Do I need to write my email and password again?"

– Participant (University of Third Age)

Finally, the participants stated that they do not use electronic agendas when they were presented with a number of tasks and the calendar and, therefore, both events and tasks are usually printed on paper. In response to this context, digital devices could synchronize to paper and/or have the option of printing the tasks and events marked on the calendar.

In view of all that has been mentioned so far, one may suppose the next step would be apply the knowledge given in their own context (progression dependent on daily events, community and strengthened link with social networks/communities…). One way to meet this challenge would be through the use of mobile technology and smart devices to monitor and share the information between multiple platforms.

Based on the participants quotes and the researcher's observation in the field, the following design elements tend to be essential when intertwining the context of the end-

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users (PHASE 1) and the determinants of wellbeing and quality of life in the design of a game-based learning programme (PHASE 2):

- **Storytelling and narrative immersion:** Encourage actions and changes in behaviour by giving it a purpose through storytelling.

  This design element was considered to be relevant, given the fact that the idea of traveling throughout time during the gameplay and the game music were seen as an added plus to the participants. For example, some of the participants stated: "*Wow, I'm impressed. The idea of travelling in time and exploring different cities and historical facts in a game was very good.*", "*I thought it was interesting – the characters involved, the history, and the places to be found [...]*"

- **Context-aware challenges:** Adapt the game challenges to the context.

  This design element was considered to be relevant, given the fact that the game could also have reinforced the interlink between the game challenges and the context. For example, some of the participants stated: "*If the game could be incorporated in my daily life and entertain me during my trips and invite me going outside – that would be nice*"; "*[...] For example, a challenge that enables us to link the information that was given to us with our daily life.*"

- **Game space:** Bring people together in both physical and digital (phygital) environment.

  This design element was considered to be relevant, given the fact that the game could also have reinforced the interlink between the game challenges to the context. For example, one of the participants stated: "*[...] We could have done these and other exercises outside.*"

- **Immediate feedback:** Provide immediate feedback towards action.

  This design element was considered to be relevant, given the fact that the participants were motivated to repeat and progress in the game with the use of immediate messages (e.g. 'Congratulations'). For example, one of the participants stated: *"You see? Congratulations, you won! I want to repeat it!"*

- **Imagery-based techniques:** Re-create sensory perception of different stimuli.

  This design element was considered to be relevant, given the fact that the game scenarios also encouraged 'the sense of being there'. For example, one of the participants stated: *"This looks familiar…It is like I've been here […] When travelling to one place, it could link the information of the game with the historical archive from the past until now […]."*

- **Bios, avatars and role-playing:** Provide information about the bios and places visited in the game in order to provide meaning to the exploration and the player experience.

  This design element was considered to be relevant, given the fact that the mini games did not enable the players to retrieve the information at any time of game-playing, forcing the player to replay and bionotes about the game characters should be provided. For example, one of the participants stated: *"Who is Sul? Who is Thomas Allinson? I need to be remembered of the story […]."*

In addition, the following two additional design elements that stem from the participants' experience with the computer-assisted learning programme were considered:

- **Social engagement, social graph and community of practice:** Embed social media and reinforce the interconnection of current online relationships.

  This design element was considered to be relevant, given the fact that the exercises should be context-based, aiming at giving the opportunity to apply the knowledge obtained to the videos and reinforcing the link with social networks, locations and

photos. For example, one of the participants stated: *"Who will answer to my doubts? My friends on Facebook? But they can if I send it to them, right?"*

- **Metamemory:** Enable a person to reflect on their memory.

This design element was considered to be relevant, given the fact that the participants liked to check their performance in terms of the challenges presented (memory-based and information retrieval) For example, some of the participants stated: *"I would like to see my grade and how well I did when compared with others […] But how can I see what I was missing and in which areas I performed better in comparison with my colleagues?"*, *"I think it is very important to check our performance – if we learnt the information that was given […]"*

Another significant aspect to provide a set of guidelines to develop game-based learning programmes for affecting active ageing are the recommendations that are provided by the experts in the Educational Sector and Industry. Therefore, the next section presents the results of the interviews with a group of Subject Matter Experts in Games, Human-Computer Interaction, Psychology and/or Ageing Studies.

B. *Interviews with Subject Matter Experts*

In regards to the Interviews with the Subject Matter Experts, their answers to the interview questions were coded using NVivo 11, following the procedures mentioned in Chapter 5, p. 149. The codes used were: Recommendations for designing age-friendly environments; Perspectives on the (Co-) Design Process; Designing for learning and behaviour change; The monetization process of a game. Table 32 shows the Effects Matrix for coded statements.

As shown in Table 32, the themes that were most cited were 'Designing for learning and behaviour change' (N=10 respondents) and 'The (Co-) Design Process (N= 8 respondents)'. The theme 'Designing for learning and behaviour change' includes information related with design elements (e.g. content, interface), disadvantages/risks, advantages and research method.

Table 32. Effects Matrix for coded statements relative to the experts' perspective on game design and age-friendly environment (N=10 respondents, Total ref.= 149)

Codes	Number of respondents	Exemplar quotes
Recommendations for designing age-friendly environments	N = 4 (N=4, 100% Educational sector)	*"Addressing ageism is a difficulty. Segregating older adults is not necessarily beneficial. The difficulty will be in creating age-friendly environments that are intergenerational."* – Interviewee 9 *"[...] such environment should be created not for older people but with older people."* – Interviewee 7
Perspectives on the (Co-)Design Process	N = 8 (N=3, 37.5% Industry; N=4, 50% Educational sector; N=1, 12.5% Both)	*"[...] design some sort of product and get user feedback. You want to get users as soon as possible so if you get a prototype, something that works, get them on it, get feedback and iterate [...]"* – Interviewee 3 *"One of the things we do is to make paper prototypes – We actually make paper video games [laugh]. We play as a sort of board game and have people talk about what things they can do and so forth – so what we can feel is – 'Is this going to work?' and then we can get them play and do refinements and so, nowadays, we are actually allowing people to be involved in the design process all the way through."* – Interviewee 2
Designing for learning and behaviour change	N=10 (N=3, 30% Industry; N=6, 60% Educational sector; N=1, 10% Both)	*"[...] technologies can most definitely trigger changes in our behaviours at both the conscious and unconscious levels. For example, simple reminders on our phones can be helpful for medication adherence behaviour. Technologies can also target our unconscious processes by releasing smells to trigger certain behaviours like eating."* – Interviewee 8
The monetization process of a game	N = 3 (N=3, 100% Industry)	*"I don't like the idea of putting obstacles in people's entertainment and the enjoyment of the game but that's precisely what free-to-play game is."* – Interviewee 5 *"[...] monetization choice is to get money to achieve, this is more 'get money to stand out from the crowd."* – Interviewee 6

In terms of the theme '(Co-) Design Process', the following information are included: advantages of co-design, disadvantages of co-design, the co-design process, and design

practices. Finally, the monetization process includes information about a set of strategies adopted (*e.g.* free-to-play model vs paid game + expansion packages) whereas recommendations for designing age-friendly environments entails the main challenges and opportunities for designing age-friendly environments.

Recommendations for designing age-friendly environments

When surveyed about the recommendations for designing age-friendly environments, the interviewees outlined the fact that these age-friendly environments should: (a) foster social connectedness and demystify ageing bias, (b) take into account different age-cohorts when addressing products to this target group; (c) not focus on age-related difficulties or illness prevention; (d) train skills through cognitive challenges and foster life-long learning, establishing a strong link with everyday life; and (e) get the participants familiar with the interfaces. A more detailed account of these recommendations is provided below.

According to interviewee 9, social connectedness and fostering a positive attitude towards the ageing process are key to design age-friendly environments. The following quotations illustrate these concerns and the importance of design to close the gap between different generations:

> *"[…] increasing social connectedness, reducing ageism and contributing to life-long learning. These aspects are very important to encourage active ageing."*

> *"[…] be aware of ageism (theirs and others) and not create a design that perpetuates it […] Addressing ageism is a difficulty. Segregating older adults is not necessarily beneficial. The difficulty will be creating age-friendly environments that are intergenerational"*

> *"One difficulty is that society often segregates by age, and if family is not living nearby, older adults may find themselves limited in their connections with other age demographics. Furthermore, younger generations may also be limited in exposure. This creates a situation where most perceptions are built on what is portrayed in the media and it can lead to stereotyping.*

When we create opportunities where different generations can work together, it can be beneficial to all parties."

– Interviewee 9 (Educational sector)

Another aspect that all interviewees highlighted relative to the design of age-friendly environments was to specify the age-cohorts of the target group because of different contexts, receptiveness to the technology and age-related difficulties. As they note:

"Such environments should be created not for older people but with older people [...]. I think that we should really try to involve them because I think that older people is a diverse group including women, men, younger-old, old-old, higher educated and non-higher educated from the very beginning."

– Interviewee 7 (Educational sector)

"Ageing is variable. A person who is 60 may be very different than a person who is 90. On the other hand, there are people who have more age-related difficulties at 65 than some who are 80. Unless you specify the target audience within the demographic (such as older adults in care homes), then your demographic incorporate a wide range of ageing factors."

– Interviewee 9 (Educational sector)

"If you take somebody who is in their 70s, 60s and in their 50s, you will see a big difference in how receptive they are relative to different types of technology – from virtual reality to a simple interface on a web browser."

– Interviewee 1 (Educational sector)

In addition, all interviewees outline the importance of providing cognitive challenges, training skills, fostering life-long learning and establishing a link with everyday life in a longitudinal way. For example:

"[...] using gamification improves the interaction in terms of the satisfaction and engagement of the user."

– Interviewee 1 (Educational sector)

"With activities such as digital play, interactions can be fun and engaging. Many games require a level of cognitive engagement, social engagement, etc. [...] designing intergenerational games where various age demographics may have skills to overcome challenges; thus, when the intergenerational players are interacting, they both take turns at having a lead role at different times. Ideally, creating a situation where both players must collaborate and cooperate to overcome the game challenge. All generations want a sense of agency."

– Interviewee 9 (Educational sector)

"Connect to their everyday life [...] there are very few studies to do in a longitudinal way – so not create an environment and then allocate resources for them once but try to follow them during more months or even years to see how this environment develops."

– Interviewee 7 (Educational sector)

Finally, the interviewee 9 draws our attention to the problem of focusing too much on age-related difficulties and illness prevention in these design attempts while the interviewee 1 reminds us of the importance of getting the participants familiar with the interfaces.

"The other is not only focus on the disease or age-related difficulties, but to make designs that also focus on the positive aspects of ageing [...] risk of seeing older adults as their age-related difficulties, and having approaches only focus on reducing this, or increasing that. It is important that the person is respected as something beyond their age-related conditions."

– Interviewee 9 (Educational sector)

"They understand TV, they understand the computer with Internet connection and they might be coerced to interact with a fitness band. Anything else, I think that it will be a struggle – they will probably try out, especially if their kids are going to us them but I don't see my parents and all the people that I've studied [...] they will not go out and buy it, especially if they spend a lot of time learning it at that age."

– Interviewee 1 (Educational sector)

Perspectives on the (Co-)Design Process

The participants argue that there is a general lack of co-design practices in both the industry and the educational sector. End-users are often involved during the gameplay testing but not during the early stages of the design process and thus, which can sometimes lead to failing to think about representative players. These are some of the interviewees' statements:

"The dominant thing that companies use still is agile development and not user-centred design - the whole idea of deploy-test-deploy-test. Unfortunately, user-centred design is still not infiltrated into companies as much as it should be. It is mostly in the testing section and perhaps a little bit in the brainstorming but not so many iterations as it should. [...] A lot of companies now, even the ones that claim to do user-centred design – you get Google, for example, [...] they claim to do a lot of user-centred design but it's not really user-centred design. I mean... If you look at the products they use, it is still agile and not UCD. It is only for the brainstorming, creating new ideas and doing some final testing that we use UCD at the moment."

– Interviewee 1 (Educational sector)

"Normally we don't really focus on test design. We can't ask all the players because we're hoping to have millions of them, right? We can try a design and we can make a prototype and we very often do that and then we invite people to play the prototype and you refine the prototype based on their feedback and so we involve them in the very early in the design stage – after the concept but before the mechanics to prototype different ideas about how to play and what feels like and so they come in and sit down and play [...]"

– Interviewee 2 (Both)

"We generally don't send it to public things until it is finished. We do a lot of internal testing – I mean, I can even use an internal and we get a kindly broad spectrum of people to play and test. A lot of games get a soft launch or go into something similar in which you can get access and then get feedback – that is the

quickest way to get into people's hands… so yeah, something like that helps. From my point of view, it is actually important to get as much feedback as you can."

– Interviewee 3 (Industry)

"Videogame designers haven't done that [co-design] at all. No. This is what I think. I think it is a Nobel aim but you have to be very clear in order to have someone that makes the final decision, otherwise you run the risk of perhaps falling."

– Interviewee 5 (Industry)

"We basically made the game in a quite prototype form and we put it out there and just said to people- tell us what you liked, what we should have done or not and how we could improve it […] our original methodology was creating the game, getting it to early release, do some testing but nothing of the level of early access, then program and release it."

– Interviewee 6 (Industry)

"The bigger problem is that they [developers] are not aware of the design process – maybe they can think about their older grandmother but they don't really understand they need to involve older people […] Everybody is telling you how important co-creation is but in the end nobody is using it. Some researchers do. In the Industry maybe they do it sometimes but they don't share the data"

– Interviewee 7 (Industry)

In regards to the procedures to take when co-designing games, interviewees highlighted the importance of low-fidelity prototypes to get player into game thinking and feedback. As Interviewee 3 points out:

"If you get a prototype, something that works, get them [the users] on it, iterate and obtain their feedback. Check whether the motivation of the target group and those ideas do not compromise the whole idea of the game.

If you're always changing the game that much from the original vision, you should consider not editing it but if it makes a better game and if you feel like that everybody

agrees, then you should edit it. As a designer producer, you're the keeper of game ideas."

– Interviewee 3 (Industry)

Similarly, Interviewee 4 and Interviewee 2 assert that having low-tech prototypes is the key to get the end-users' involvement and feedback:

"I realized that if we had more technical applications, it might get more difficult to involve people in all points of the design. The point is not quality assurance. The point is to get into this kind of thinking"

– Interviewee 4 (Educational sector)

"One of the things that we do is make paper prototypes. We actually make paper video games [laugh]. We play as sort of a board game and have people talk about what things they can do and so forth – so what we can feel is – 'Is this going to work?' and then we can get them play and do refinements and so, nowadays, we are actually allowing people to be involved in the design process all the way through. So when a game is almost finished then we let the general community to start to playing it and look for bugs. Now, we start to release an alpha test, which means that the game barely works at all [laugh] and we let people play it and look for bugs. So, we're getting feedback from them all the time. [...] The approach you might vote is to imagine a representative player ['Who is the person you're really trying to reach?' and put yourself in their shoes and become your representative players and think yourself – Will my player enjoy doing this?]"

– Interviewee 2 (Both)

However, co-design has been subjected to considerable criticism as game designers and producers must be careful in order to manage the whole process and often the player doesn't even know what (s)he wants in the gameplay.

"I don't believe in design by community and I don't believe in just following the market. You know… completely letting the player to define everything because I still

have a sort of cultural theory on game design. I believe that there should be a cultural personality about game designers."

– Interviewee 2 (Both)

"If you ask players what they want, perhaps what they want is bigger, better and more realistic than they have had before [...] If it is managed correctly then you'll end with something that everybody wants, everybody has contributed to and feel good about it."

– Interviewee 5 (Industry)

In response to this challenge relative to the co-design process, Interviewee 5 stated:

"There are several points to decide before: What would you like to involve them? Involve them in the design of the story is completely different from involving them in the user interface [...]. What I also think is that you should help them so you should not just say 'ok, we're going to create a game – what do you want?' So you've got to help them, maybe give different options – which option would you like and then see what they tell you [...] Maybe you can't do everything but you should involve them in the very early stage and maybe you get an advice from people that you would never think of."

– Interviewee 7 (Educational sector)

It is worth mentioning that an agreement between the end-user and the designer team should be also settled. Commenting on the designer's authorship and the involvement of the end-users, Interviewee 1 states: "*[...] when you get your end-user developing product ideas and feedback, make sure them to sign a non-disclosure agreement saying that anything the user gives, may be used to develop a game or a product.*"

Designing for learning and behaviour change

When designing for learning and behaviour change, the interviewees made the following recommendations: (a) reinforce the presence of the player in the environment; (b) stimulate the players' subconscious by overweighting internal motivation (i.e. skills, beliefs, self-efficacy) and external elements that leads to human behaviours; (c) use social

elements, scenario building and changes in the game plot; (d) interlink between cognitive and affective dimensions; (e) strengthen the dialogue between both game-design and the subject area; and (f) establish a link between games and outdoor activities and rely heavily on notifications. Nevertheless, the interviewees highlighted two main problems with game-like activities to shape behaviour – i.e., both manipulation of behaviours and too much focus on PBLs (Points, Badges and Leaderboards).

For example, some interviewees highlighted the players' state of immersion and presence in the mediated environment to be fundamental to changes in behaviours. Different *stimuli* and reminders of activities were also referred to be important to adhere to certain behaviours. As Interviewee 1, Interviewee 8 and Interviewee 10 put it:

> *"Designing any sorts of information architecture-based structure so that the user feels that this is easy to do and he is in the right place, whether subconsciously or by choice. They are given the opportunities to go to a path that will give them the best benefits and understand the information given."*

> *– Interviewee 1 (Educational sector)*

> *"Technologies can most definitely trigger changes in our behaviours at both the conscious and unconscious levels. For example, simple reminders on our phones can be helpful for medication adherence behaviour. Technologies can also target our unconscious processes by releasing smells to trigger certain behaviours like eating."*

> *– Interviewee 8 (Educational sector)*

> *"Serious games can also be used to encourage changes in behaviour. For example, behaviour changes can be achieved through educational messages or by encouraging the player to undertake certain activities that are linked to game based events such as rewards or comparing scores. This type of game element is linked to "Gamification". Gamification is the name given to the process of applying gaming elements / mechanics to a non-game activity to improve motivation. For example, a fitness tracking app might use points for exercise activities or give users exercise challenges that they need to complete."*

> *– Interviewee 10 (Educational sector*

Another important aspect is the affective dimension beyond the cognitive one in order to learn and have an impact on the players' behaviours. This can be enhanced through the use of social elements, scenario building and changes in the game plot. These recommendations are supported by the following statements:

"[...] a cognitive dimension and an emotional/affective dimension. I think that these two need to be interconnected but then we need to think about the information from the start and the relational, emotional things are also important. It is a point I'd recommend that we look at when talking about behaviours – not only the cognitive dimension but also the affective one."

– Interviewee 7 (Educational sector)

"I think that particularly with the multiplayer games, people learn the social aspects of group-based activities like multi-group raids or solving problems together. They can organize the learner to cooperate, I mean, they can be a vital force on socialization [...]. Games can encourage behaviours and learning through sociability, training skills like logic or memory and attention and so forth."

– Interviewee 5 (Industry)

"[...] specially in social games, they can learn about the community, what's right and what's wrong."

– Interviewee 3 (Industry)

"You can do it through simple changes in the plot. If you have a fixed pre-defined ranging plot and so when the player makes some sort kind of decisions, then you go down some sorts of paths in the plot and so they come to experiences that show the consequences of their actions. When you do something good, you have good consequences and so on. So you can do it through the plot but you can also build a lot of variety into the character and have the system consequently watching what the player does and change the outcome based on what the player is doing. So, for example, right now all the mobile games are watching how long you play."

– Interviewee 2 (Both)

The need of strengthening the dialogue between both game-design and the subject area also surfaced relative to the challenges posed to the design of games for learning and changes in behaviours. As Interviewee 2 points out:

> *"The problem is that Subject Matter Experts usually know nothing about game design, and the game designers really don't understand the subject. The result is often a game that isn't much fun, or a game that is lots of fun but doesn't impart any understanding of the subject (or incentive to change behaviour). Game designers must learn to talk to the experts."*
>
> – Interviewee 2 (Both)

Finally, Interviewee 2, Interviewee 3 and Interviewee 10 suggest to establish a link between games and outdoor activities and rely heavily on notifications.

> *"Pervasive games depend on having lots of outdoor things to do and creating reasonable incentives to go there. For an active ageing pervasive game, I think you would need to provide some kind of incentive to actually be in the places where you go and that will require tying the landscape to the game. It might be necessary to make versions of the game that are customized for individuals' towns and cities, for example."*
>
> – Interviewee 2 (Both)

> *"I'd bet heavily on notification [...] to remind to do things. If it something that it is interesting like continuing the story, I think that is what really gets you motivated to do a bit more. If you can create a game or a story in which doing these things will give sufficiently cognition to the user at the point that they don't get annoyed when they do that. I think that is the perfect sweet spot that you're looking for."*
>
> – Interviewee 1 (Educational sector)

> *"One of the main challenges regarding changing behaviour is getting a user to actually change their behaviour in the real world. Technology can help to overcome this. For example, smart watches can be combined with Gamification techniques to continually monitor a user and give them feedback on their progress. In addition, technology, such as virtual reality, motion controllers, motion sensors (e.g. Xbox*

Kinect) can be used to create more immersive learning experiences by allowing a player to physically act out required behaviour. This also has the potential to increase engagement."

<div align="right">– Interviewee 10 (Educational sector)</div>

There are a number of problems, however, to be considered when applying games to learning and changes in behaviour. Concerns were expressed about manipulation or ethics and too much focus on external motivation and Points, Badges and Leaderboards. For example, these were the issues presented by the interviewees 4, 5 and 8:

"I see some problems with using games and gamification to shape behaviour, of course - there is a huge ethical discussion even when using it for a good reason [...]. All the techniques that we developed that can shape behaviour could be caught by the army, advertisement or insurance. What I see in many gamification and serious games applications but also in many commercial applications is a very behaviourist approach to human motivation, so you do something- you get a reward- you do something - you get a reward - you do something- you get a reward, which I think it can work in a short-term but I don't think it can go very far – you can't change behaviours in the short-term but you can change mind-sets."

<div align="right">– Interviewee 4 (Educational sector)</div>

"Trying to gamify everything becomes a bit forced, which is to think about in some certain ways, i.e. people getting rewards every time they take something...Some things are quite good at like social media [...] but oddly the responsibility of that, you know, making things potentially that are healthy for people and that kind of Facebook likes, for example, which is kind of some game-like, for instance, a reinforcement of what you've done it...I think that's an area that probably needs a lot more study at the moment."

<div align="right">– Interviewee 5 (Industry)</div>

"There is limited agreement on which game features support effective learning, how to engage learners and what outcomes can/can't be achieved through game-based learning. In addition, game-based learning can lead to undesirable outcomes. For

example, in a business environment large amount of game-based learning can lead to excessive competition that inhibits collaboration between employees. Therefore, collaboration and cooperation may also need to be incorporated as part of the game. Serious games can also move a player's focus from learning to winning. This can result in the intended outcomes from the game not being met."

– Interviewee 10 (Educational sector)

"Interventions need to be tailored to the individual and adapt to the context of behaviours. Some people more prone to manipulation than others where perhaps those with low informational literacy will be the most vulnerable. The commercial world is extremely clever at influencing our behaviours such as buying a product. They do this largely through targeting our unconscious processes. So increasing our information literacy could help to interfere with this pathway and make users' aware of these manipulations."

– Interviewee 8 (Educational sector)

To overcome these problems, the interviewee 10 points out:

"Informational literacy can assist in the changing of behaviour as it encourages people to identify the need for information, locate it, evaluate it, and apply it to assist in changing behaviour. The information being sort has a role to play on the effectiveness of informational literacy. For example, health information can be activity pursued or avoided in order to delay the acquisition of the information. The pursuit of information in the case of health may depend on a variety of factors, such as an individual's traits and confidence."

– Interviewee 10 (Educational sector)

The monetization process of a game

Opinions differed relative to the monetization strategy adopted in the game. Even though, on the one hand, Interviewee 3 argues for a free-to-play model, on the other hand, there are some game producers (i.e. Interviewee 5 and Interviewee 7) that suggest other alternatives to this model. In defence to the free-to-play model, Interviewee 3 states:

"Let's focus on actually let people play the game and get free stuff. Yes, they [inspiring game in which the interviewee based his monetization model] put a video advert in there, which is an optional thing (you don't have to watch it) [...] on the subconscious level it played with people because you know as I said they watch a video advert and they can get a certain amount of coins. That method 'free to play' is retaining your customers, which is really important. If you try to monetize something, you need customers, you need them playing for a certain amount of time [...]."

– Interviewee 3 (Industry)

The main weakness with this approach presented by Interviewee 5 and Interviewee 7, however, is to put obstacles in people's entertainment as it is likely to constantly interrupt the gameplay experience. Their suggestions were paying for the guilds/groups and be rewarded or giving a faithful price and adding extra hidden packages. As the interviewees put it:

"I don't like the idea of putting obstacles in people's entertainment and enjoyment of the game but that's precisely what free-to-play game is. [...] No! What I was trying to get implemented in the last project that I worked on and there was some resistance to get it done, was the idea of making a much more cooperative community-based game... So... People are paying money not just for themselves but they're also paying for their groups/guilds/clans/whatever. They are paying for something that benefits everybody, who is in the group and they can also be the person who has provided things for everybody else and get some in-game benefit."

– Interviewee 5 (Industry)

"The issue with free-to-play model is that you have to stop it [the game] with something that is bored [...]. More and more big titles like Destiny are giving players a faithful price of the game, adding two or three expansion packages [...] – visual UI items that you'd not be able to achieve through normal game-playing, which allows your character to stand out from the crowd. Monetization choice is about get money to achieve – this is more getting money to stand out from the crowd." – Interviewee 3 (Industry)

Together, these interviews indicate that the following recommendations to develop the learning programme are:

a) Take into account different age-cohorts when addressing products to this target group;

b) Not focus on age-related difficulties or illness prevention;

c) Train skills through cognitive challenges and foster life-long learning, establishing a strong link with everyday life;

d) Get the participants familiar with the interface;

e) Get players into game thinking and feedback in the early stage of the game development but be prepared to manage the whole process and make final decisions;

f) Reinforce the presence of the player in the player environment;

g) Stimulate the players' subconscious by overweighting internal motivations (i.e. skills, beliefs, self-efficacy) and external elements that leads to human behaviours;

h) Use social elements, scenario building and changes in the game plot in order to foster changes in behaviour;

i) Establish an interlink between cognitive and affective dimensions;

j) Strengthen the dialogue between game-design and the subject area;

k) Establish a link between games and outdoor activities and rely heavily on notifications; and

l) Monetize the game to stand out from the crowd instead of associating it to the general game achievement.

6 THE EFFECTIVENESS OF THE LEARNING PROGRAMMES

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GAME-BASED LEARNING FOR ACTIVE AGEING

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Conclusion

« Change is the end result of all true learning »

– Leo Buscaglia (Banhegyi & Banhegyi, 2007, p. 9)

CONCLUSION
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Conclusion

This thesis concludes that when designing learning programmes for active ageing, the health-related wellbeing and quality of life domains - environment, mental health, social functioning, general health and vitality should be considered whereas metamemory, immediate feedback, context-aware challenges, storytelling/bios and role-playing, imagery-based techniques and social engagement are of utmost importance as design elements. The answer to the research question is provided, its contributions to the Information and Communication Sciences, Limitations and Future Work.

Addressing the research question and hypotheses

This thesis has sought to answer the research question 'In what way can game-based learning affect active ageing?'. As a sequential mixed-method approach was required to identify these components and provide us with a better understanding of the research problem, a set of sub-questions and hypotheses needed to be addressed beforehand (PHASE 1 – The Participatory Action Qualitative Research, PHASE 2 - The Quantitative Experimental Research, and PHASE 3 - The Mixed-method Research).

During the PHASE 1, a Participatory Action Qualitative Research was carried out with the aim of understanding the main design components that a learning programme should have for affecting active ageing. Hence, 33 adult learners (G0) at a University of Third Age were involved in the co-design sessions of two learning programmes (Game-Based

Learning Programme – GBLP; Computer-Assisted Learning Programme – CALP), and then both prototypes were developed.

In response to the research sub-question for the PHASE 1, 'What are the main design components that a digitally-mediated learning programme should have for affecting active ageing?', the results have revealed that digitally-mediated learning programmes should: (a) present cognitive challenges (improve cognitive capacity); (b) monitor the participants' progress in the platform and reward their activity (improve self-esteem, self-confidence and personal fulfilment); (c) be flexible in terms of timetable (flexibility in schedules); (d) enable information sharing with people who have common interests; (d) foster self-discovery and scaffolding; (e) organise the learning content in terms of goals/missions; (f) present multimodal texts and schemas that illustrate the learning content; (g) connect the learning content and goals to daily activities; (h) enable the participants to contribute with their own content to the course; and (i) provide information about the 'source of information.'

Based on the definition of 'Active Ageing' proposed by the World Health Organization (2002), the recommendations were then extended to the different domains that embody its definition (Themes related with Health – Physical exercise, and Nutrition; Security and Participation in Society).

Relative to the Physical Exercise, the design requirements were: (a) include breathing exercises beyond agility and balance exercises; (b) use time frequency and accuracy of the exercises performed as Key Performance Indicators (KPI); (c) reinforce social support networks in order to encouraging physical activity; (d) enable the participants to schedule physical exercises and share their progress; and (e) simulate exercises to practice.

The design requirements for both platforms in terms of nutrition were: (a) present different types of diets and how the individuals' diet can be influenced by external factors; (b) offer the possibility to share the type of nutrients consumed and inform the participants about macro- and micro-nutrients; (c) draw the participants' attention to drink water daily; (d) enable the participants to plan and manage cooking events; (e) take into account the participants' concern with their body shape and weight as well as the body images presented in both platforms; and (f) provide information about the nutrients of certain types of food.

In regards to the design requirements for both platforms in terms of security and participation in society, these were: (a) the possibility of using the learning programme at home but assist the adult learner outdoors; (b) encourage the participants to act upon their environment and political decisions; (c) simulate a real scenario in which basic Human Rights were violated and educate for Human dignity and rights.

When developing the Computer-Assisted Learning Programme (CALP), the design decisions were based on the following procedures: develop an audio-visual strategy that both triggered narrative immersion and at the same time allowed the learner to become familiar with the source of information (mentor's credibility); (b) foster self-knowledge ('know thyself'); (c) reward task-management; and (d) build a community of practice. Hence, the learning programme was divided into the areas: Learning; Rewards/ Analytics; Learning Plan and Social. The following activities that learners could do were: schedule their learning events (Learning Plan); share their views on the learning content (Social); be awarded by tasks and exercises performed (Rewards/Analytics); enrol in courses and different subjects and watch videos related with the content and share doubts relative to a certain minute of the video (Learning).

For the game-based learning strategy, the design decisions were based on the following requirements: (a) introduce history-related narrative and scenarios; (b) foster similarity with reality; (c) provide different game levels in order to get the players acquainted with challenges and then foster a 'discover-it-yourself' attitude; (d) present multimodal texts and schemas that illustrate the learning content; (e) include breathing exercises beyond agility and balance exercise; (f) simulate exercises to practice; (g) present different types of diets and how the individuals' diet can be influenced by external factors; (b) draw the participants' attention to drink water daily (progress bar dependent on the number of cups of water drunk); (c) provide information about the nutrients of certain types of food; and (d) connect the learning content and goals to daily activities (*e.g.* food that contain certain vitamin); and (e) simulate a real scenario in which basic Human rights were violated and educate for human dignity and rights.

Having discussed the main design components that a learning programme should have for affecting active ageing, assessing the effectiveness of a Game-based Learning programme for encouraging active ageing in comparison with a Computer-assisted

Learning Programme was needed. Thus, in PHASE 2, a total of 60 adult learners at 4 Universities of Third Age were assessed in terms of their perceived health-related wellbeing and quality of life (the ultimate goals of active ageing), before, during and after each experiment, using the SF36v2 and WHOQOL-BREF scales. In total, there were 3 groups: The Experimental Group (G1) (20 learners), who tested firstly the GBLP and then the CALP; The Comparison Group (G2) (20 learners), who tested firstly the CALP and then the GBLP; and the Control Group (G3) (20 learners) that did not take part in the intervention. The initially hypotheses were, therefore, formulated:

- H_0: There are no significant differences between the type of experiment undertaken by each group (G1, G2 or G3) and their perception of wellbeing and quality of life;
- H_1: There are significant differences between the type of experiment undertaken by each group (G1, G2 or G3) and their perception of wellbeing and quality of life.

Findings have suggested that although no significant differences between the type of experiment undertaken by each group and their perception of wellbeing and quality of life were observed, there were significant differences between the group type and their perception on mental health (F $(2,57)$ = 3.771, p= .029) and general health-related wellbeing (F$(2,57)$ = 5.231, p= .008) in which the GBLP showed improvements relative to the CALP. However, there is not observed a large effect

In addition, the results have also revealed that the environment quality of life domain seemed to be correlated with the participants' Confidence to solve Daily Problems (G1: r=.514, p=.02; G2: r=.489, p=.03), Motivation to Participate in Society (G1: r=.554, p=.01), Decrease in Ageing Bias (G2: r=-.678, p< .01), and Finding solutions to Problems (G2: r=.509, p=.02). The psychological domain seemed to be correlated with the Decrease in Ageing Bias (G2: r=-.49, p=0.03). In regards to health-related wellbeing, the mental health domain seemed to be correlated with the confidence to solve daily problems (G2: r=.524, p=.02) and motivation to participate in the community (G2: r=.583, p< .01). In addition, the general health, vitality and social functioning seemed to be correlated with the participants' confidence to solve daily problems (G2: r=.59, p< .01; r=.624, p< .01; r=.481, p= .03) and motivation to participate in the community (G2: r=.79, p< .01; r=.49,

p= .03; *r*=.476, *p*= .03). Finally, the role-functioning also seemed to be correlated with the decrease in ageing bias (r=-4.73, p=.04).

One may suppose that the following quality of life and health-related domains are relevant to build an instrument for designing and assessing the effectiveness of a programme for wellbeing and quality of life: Environment, Mental Health, Social Functioning and Vitality. Given the definitions of each domain (p. 146-148) and the experience carried out in PHASE 1, the following questions/requirements are proposed in this thesis:

- *Does it provide information about health and social care*?
- *Does it foster opportunities for acquiring new information and skills?*
- *Does it encourage the players to participate in in-doors and outdoor recreation/leisure activities?*
- *Does it help the player to cope with emotions?*
- *Does it create awareness of the players' own behaviours and emotions, when (s)he is playing the game?*
- *Is there any sort of the type of pleasure (e.g. physio-, socio-, psycho- or ideo-) associated to the game-playing activity?*
- *Does it create empathy with the end-users towards health-related problems (e.g. homophily with game characters)*?
- *Does it encourage the discussion of the simulated scenarios in daily life?*
- *Does it encourage the player to adhere to health-related habits?*
- *Does it enable scaffolding through health-related activities?*

Finally, there was a need to understand the interrelationship between the determinants of the health-related wellbeing and quality of life domains (PHASE 2) in the design of a Game-based Learning Programme (PHASE 1). Thus, the mixed-method question 'How do the design components of the learning programmes mentioned by the adult learners help to explain the influence of game-based learning on the adult learners?' wellbeing and quality of life?' was analysed (PHASE 3).

In this PHASE, the information obtained in the previous phases (PHASE 0, PHASE 1, and PHASE 2) was compiled and crossed with the data obtained from group discussions with G1 and G2 about the pros and cons of each experiment and a set of recommendations provided by a group of experts in the domains of Games, Human-Computer Interaction, Psychology and/or Ageing Studies.

The results from group discussions with G1 and G2 about the pros and cons of each experiment have revealed a set of design components that can help to establish the link between the recommendations previously identified about the design of the learning programmes and the health-related wellbeing and quality of life domains:

- *Metamemory*: Enable a person to reflect on their memory;

- *Immediate feedback*: Provide immediate feedback towards actions in order to encourage repetition of actions-behaviours;

- *Context-aware challenges:* Adapt the game challenge to the context;

- *Storytelling and narrative immersion:* Encourage actions and changes in behaviour by giving it a purpose through storytelling;

- *Bios, avatars, role-playing:* Provide information about the bios and places visited in the game in order to provide meaning to the exploration and the player experience;

- *Game space:* Bring people together in both physical and digital (phygital) environment;

- *Imagery-based techniques:* Recreate sensory perception of different stimuli;

- *Social engagement, social graph and community of practice:* Embed social media and reinforce the interconnection of current online relationships.

Moreover, the interviews with Subject Matter Experts were able to identify a set of additional requirements that can influence the adoption of Game-based Learning for active ageing. These were:

a. Take into account different age-cohorts when addressing products to this target group;

b. Not focus on age-related difficulties or illness prevention;

c. Train skills through cognitive challenges and foster life-long learning, establishing a strong link with everyday life;

d. Get the participants familiar with the interface;

e. Get players into game thinking and feedback in the early stage but be prepared to manage the whole process and make final decisions;

f. Reinforce the presence of the player in the player environment;

g. Stimulate the players' subconscious by overweighting internal motivations (i.e. skills, beliefs, self-efficacy) and external elements that leads to human behaviours;

h. Use social elements, scenario building and changes in the game plot;

i. Establish an interlink between cognitive and affective dimensions; and

j. Strengthen the dialogue between game-design and the subject area.

Overall, the findings from this study are in accordance with the framework presented by Calvo and Peters (2014) in which technology can have an impact on human potential and wellbeing by fostering positive emotions and allocating 'remembering experiences'; encouraging autonomy, competence and self-actualization; creating self-awareness and self-compassion through metacognition, experimental cognition, affect and behaviour; investing in mindfulness interventions; and reinforcing empathy, compassion and altruism through storytelling, role-play and communal goals. This study extends current knowledge on the use of games for active ageing, wellbeing and quality of life, giving a noteworthy contribution to the main factors to consider when designing and assessing digital games that go beyond the entertainment purposes.

Final thoughts and research contributions to the Information and Communication Science

This research set out to determine the main design components that a Game-based Learning Programme should have in order to encourage active ageing. As many challenges have brought to the fore to the Human-Computer Interaction field with the pulverization of Information and Communication Technologies and the delivery of Infrastructures, Platforms and Software as a service (IaaS, PaaS, and SaaS), there is a current need to determine the design factors that can go beyond the mere use of usability, efficiency, effectiveness, satisfaction or experience of use when designing and assessing such platforms.

In a constantly-changing 'Smart' ecosystem in which reciprocal affordances between the end-users and the environment are constantly mediated with the use of daily used devices, one may suppose that emotional and behavioural design have become of utmost importance to bring a much more humanistic approach to the Human-Computer Interaction field and thus embody such aspects as resilience, happiness, empathy, altruism, wellbeing and quality of life.

Another aspect is that Game-based Learning programmes are a source of Information and Communication settled in our culture and global society, being 'mental/emotional representations' and 'shaped by social interactions'(Silva & Ribeiro, 2002, p. 37). As such, this study enhances our understanding of the use of co-design to involve the end-users in these mental/emotional representations and the way the design decisions made can facilitate or not the process of transmiting and decoding the meaning of the information provided.

In addition, this study addresses the effectiveness of digital platforms to learn and encourage participation in society and overcome the problems of social divide as the current demands for the Information and Communication Society often exclude certain groups either by their age, lack of participation in the labour workforce, health status or learning difficulties.

However, caution must be applied as the belief that technology would be the driving force of society, economics and the environment is still prevalent in the Information Age and any type of determinism can be dangerous to every policy maker. Hence, technology is considered as only a mediator variable in the equation of the interrelationship between humans, cognitive and emotional representations and the surrounding environment.

Limitations and future directions

A number of limitations of this research should be considered. Firstly, a convenience sample was used, so attempts to generalize beyond these respondents are not warranted and results should be interpreted with caution.

Due to time constraints for implementing the game prototype, both the social component and inventory were not implemented. In order to overcome this limitation in a timely manner, a disqus comment system was implemented in the page that contained the game embedded as well as daily-life missions. This could have affected the participants' in-game experience. In the same vein, the game graphics were not optimized in order to balance realism and game processing, leading to delays in load time.

Relative to the Quantitative Experimental Research, although there were significant differences between the group type and their perception on mental health and general health-related wellbeing, there is not a large effect (low F-value) and, therefore, results must be interpreted with caution.

A longer time interval between each assessment of the participants' wellbeing and quality of life should have been established in order to observe in much more detail the use of each platform and confirm whether changes in the data obtained were due to the impact of the use of the learning platforms or other factors.

Given the limitations, future work needs to be done in order to increase the number of participants per group and extend this research to other Universities of Third Age from different countries.

Another group of discouraged learners outside of the Universities of Third Age could be also considered in order to see whether the Universities of Third Age had an impact on the

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adoption of the platforms and if previous motivation to learn would be a determinant factor to the use of the the learning platforms.

Both the learning platforms serve as proof of concept and they could be improved. The interrelation between these platforms and daily-life missions should also be reinforced by using daily-life objects.

Finally, a scale for designing and assessing the effectiveness of technology-mediated artefacts based on this experiment can be studied and tested by taking the different design factors and wellbeing and quality of life domains as constructors.

References

References

Aarsand, P. A. (2007). Computer and Video Games in Family Life: The digital divide as a resource in intergenerational interactions. Childhood, 14(2), 235–256. doi: https://doi.org/10.1177/0907568207078330

Abras, C., Maloney-Krichmar, D., & Preece, J. (2004). User-centered design. In W. Bainbridge (Ed.), *Berkshire Encyclopedia of Human-Computer Interaction* (p. 763-767). Massachusetts, USA: Berkshire Publishing Group LLC

Abt, C. C. (1987). *Serious games*. London, EN: University Press of America.

Ackerman, D. (1999). *Deep play.* New York, USA: First Vintage Books Edition.

Ahmed, T., & Haboubi, N. (2010). Assessment and management of nutrition in older people and its importance to health. *Clinical Interventions in Aging*, 5, 207-216.

Aison, C., Davis, G., Milner, J., & Targum, E. (2002). *Appeal and interest of video game use among the elderly* [Working Paper].Harvard Graduate School of Education

Allen, M. W. (2011). *Designing successful e-learning: Forget what you know about instructional design and do something interesting* (Vol. 2). San Francisco, USA: John Wiley & Sons.

Almeida, L. D. A., de Almeida Neris, V. P., de Miranda, L. C., Hayashi, E. C. S., & Baranauskas, M. C. C. (2009). Designing inclusive social networks: A participatory approach. In Ozok A.A., Zaphiris P. (eds) *International Conference on Online Communities and Social Computing*. OCSC 2009. Lecture Notes in Computer Science, vol.5621. Springer, Berlin, Heidelberg (pp. 653–662).

American Council on Education (2008). *Higher Education for Older Adults. Second Report Reinvesting in the Third Age: Older Adults and Higher Education* (Report). Retrieved from https://prescottollinewsletter.files.wordpress.com/2010/10/mapdirections.pdf (Access date: Nov 8, 2017)

Amichai-Hamburger, Y. (2009). *Technology and psychological well-being.* Cambridge, UK: Cambridge University Press.

Andone, D., & Vasiu, R. (2013). The use of eLearning for an Age Friendly City (TAFCITY). In: Kommers, P., Kasparova, E., Bessis, N. (Eds.) *IADIS - International Conference Web-Based Communities and Social Media*, 65-70

Arnowitz, J., Arent, M., & Berger, N. (2010). *Effective prototyping for software makers.* San Francisco, CA: Elsevier.

Ashton, J., Grey, P., & Barnard, K. (1986). Healthy cities — WHO's New Public Health initiative. *Health Promotion International*, 1(3), 319–324. https://doi.org/10.1093/heapro/1.3.319

ASLERD. (2016). *Timisoara Declaration - Better Learning for a Better World through People Centred Smart Learning Ecosystems*, 1–9. Retrieved from http://www.mifav.uniroma2.it/inevent/events/aslerd/docs/TIMISOARA_DECLARATION_F.pdf (Access date: Nov 8, 2017)

Australian Right Commission. (2010). *Age Discrimination - exposing the hidden barrier for mature age workers* (Report). Retrieved from http://www.humanrights.gov.au/sites/default/files/document/publication/hiddenbarrier2010.pdf

Baek, Y., & Whitton, N. (2013). *Cases on Digital Game-Based Learning*. Hershey, USA: IGI Global

Bakaev, M., Ponomarev, V., & Prokhorova, L. (2008). E-learning and elder people: Barriers and benefits. In IEEE Region 8 International Conference on *Computational Technologies in Electrical and Electronics Engineering, 2008. SIBIRCON 2008*. (pp. 110–113). doi: https://10.1109/SIBIRCON.2008.4602586

Baltes, P. B., & Baltes, M. M. (1993). *Successful aging: Perspectives from the behavioral sciences* (Vol. 4). Cambridge, UK: Cambridge University Press.

Bandura, A. (1971). *Social Learning Theory*. New York, USA: General Learning Press

Banhegyi, S. G., & Banhegyi, E. M. (2007). *The Art and Science of Change*. Steve Banhegyi and Associates, STS Trust.

Baranowski, T., Buday, R., Thompson, D. I., & Baranowski, J. (2008). Playing for Real. Video Games and Stories for Health-Related Behavior Change. *American Journal of Preventive Medicine*. https://doi.org/10.1016/j.amepre.2007.09.027

Bateson, G. (1972). *Steps to an ecology of mind: Collected essays in anthropology, psychiatry, evolution, and epistemology*. Illinois, USA: University of Chicago Press.

Beck, J. S. (2011). *Cognitive behavior therapy: Basics and beyond*. New York, USA: Guilford Press.

Benade, R. (2011). *Pan Narrans: architecture and 21st century storytelling* [Master's Thesis]. University of the Witwatersrand, South Africa. Retrieved from http://wiredspace.wits.ac.za/handle/10539/10657 (Access date: Oct 8th, 2017)

Benavente, A., Rosa, A., Costa, A., Ávila, P. (1996). *A literacia em Portugal: resultados de uma pesquisa extensiva e monográfica*. Lisbon, PT: Fundação Calouste Gulbenkian, Conselho Nacional de Educação.

Bengtson, V. L., & Roberts, R. E. (1991). Intergenerational solidarity in aging families: An example of formal theory construction. *Journal of Marriage and the Family,* 856-870. doi: 10.2307/352993

Berdanier, C. D., Dwyer, J. T., & Feldman, E. B. (2007). *Handbook of nutrition and food*. Boca Raton, FL: CRC Press.

Bergamaschi, M. A. (2002). Memória: entre o oral e o escrito. *History of Education Journal*, 6(11), 131–146.

Berk, L. E., & Winsler, A. (1995). *Scaffolding Children's Learning: Vygotsky and EarlyChildhood Education.* NAEYC Research into Practice Series. Vol. 7, Washington,USA: National Association for the Education of Young Children

Biddle, S. J. H., & Mutrie, N. (2007). *Psychology of physical activity: Determinants, well-being and interventions*. Oxon, UK: Routledge.

Biesta, G. (2011). The ignorant citizen: Mouffe, Rancière, and the subject of democratic education. S*tudies in Philosophy and Education*, 30(2), Netherlands: Springer, 141-153. doi: https://doi.org/10.1007/s11217-011-9220-4

Bloom, B.S. (1981). *All our children learning: A primer for parents, teachers, and other educators.* New York, USA: McGraw-Hill Companies.

Bloor, D. (2002). *Wittgenstein, rules and institutions.* London, UK: Routledge.

Bødker, S., Grønbæk, K., & Kyng, M. (1993). Cooperative design: techniques and experiences from the Scandinavian scene. In D. Schuler & A. Namioka (Eds.) *Participatory Design: Principles and Practices*, 157–175.

Bond, J., & Corner, L. (2004). *Quality of life and older people*. Berkshire, England: McGraw-Hill International.

Botero, A., & Hyysalo, S. (2013). Ageing together: Steps towards evolutionary co-design in everyday practices. *CoDesign*, 9(1), 37–54. doi: http://dx.doi.org/10.1080/15710882.2012.760608

Bouma, H., Fozard, J. L., Bouwhuis, D. G., & Taipale, V. (2007). Gerontechnology in perspective. *Gerontechnology*, 6(4), 190-216

Bowers, J., & Pycock, J. (1994). Talking through design: requirements and resistance in cooperative prototyping. In *Proceedings of the SIGCHI conference on human factors in computing system,* , New York, USA: ACM, 299–305. doi: 10.1145/191666.191773

Bowlby, J. (1982). Attachment and loss: Retrospect and prospect. American journal of Orthopsychiatry, 52(4), 664.

Bowling, A. (1993). The concepts of successful and positive ageing. *Family Practice*, 10(4), 449–453. doi: https://doi.org/10.1093/fampra/10.4.449

Bowling, A. (2005). *Ageing well: Quality of life in old age*. Berkshire, UK: McGraw-Hill Education.

Bowling, A. (2008). Enhancing later life: how older people perceive active ageing? *Aging and Mental Health*, 12(3), 293–301. doi: http://dx.doi.org/10.1080/13607860802120979

Boy, G. A. (1997). The group elicitation method for participatory design and usability testing. *Interactions*, 4(2), 27–33. doi: 10.1145/245129.245132

Brandao, M. P., Pimentel, F. L., Silva, C. C., & Cardoso, M. F. (2008). Risk factors for cardiovascular disease in a Portuguese university population.*Revista Portuguesa de Cardiologia*, 7-25

Brander, A. A. (2008). Factors Influencing Participant Motivation and Engagement in the Michigan Youth Farm Stand Project. Retrieved from

http://www.aaaeonline.org/Resources/Documents/Research%20Conference%20Proce edings,%20North%20Central%202008.pdf#page=37 (Access date: Nov 8th, 2017)

Brandt, E., & Grunnet, C. (2000). Evoking the future: Drama and props in user centered design. In *Proceedings of Participatory Design Conference* (PDC 2000) (pp. 11–20). Retrieved from https://www.researchgate.net/profile/Eva_Brandt/publication/238697873_Evoking_th e_future_drama_and_props_in_user_centered_design/links/0deec5367607449ef40000 00/Evoking-the-future-drama-and-props-in-user-centered-design.pdf (Access date: Nov 8th, 2017)

Broadbent, D. E. (1982). Task combination and selective intake of information. *Acta psychologica*, 50 (3), 253-290.

Brooks, A. L., Brahnam, S., & Jain, L. C. (2014). Technologies of Inclusive Well-being at the Intersection of Serious Games, Alternative Realities, and Play Therapy. In A. Brooks, Brahnam, L. Jain (Eds.) *Technologies of Inclusive Well-Being.* Brooks Springer. Heidelberg, Germany: Springer-Verlag Berlin

Bruce, C. S. (2004). Information literacy as a catalyst for educational change. A background paper. In Danaher, Patrick A. (Ed.) *"Lifelong Learning: Whose responsibility and what is your contribution?", the 3rd International Lifelong Learning Conference*, 13-16 June 2004, Yeppoon, Queensland.

Bruner, J. S. (1979). *On knowing: Essays for the left hand.* Cambridge, Massachusetts: Harvard University Press.

Buchan (1848). *Domestic medicine - A treatise on the prevention and cure of diseases by regimen and simple medicines: with observations on sea-bathing, and the use of the mineral waters*. Boston: Otis. Retrieved from http://hdl.handle.net/2027/chi.24290817?urlappend=%3Bseq=11 (Access date: Nov 8th, 2017)

Butler, C. B. (2005a). Age-related paradigms. *New Directions for Adult and Continuing Education*, 2005(108), 61–68. https://doi.org/10.1002/ace.198

Butler, R. N. (2005b). Ageism: Looking back over my shoulder. *Generations,* 29(3), 84–86.

Caillois, R. (2001). Man, play, and games. Illinois, USA: University of Illinois Press.

Calvo, R. A., & Peters, D. (2014). *Positive Computing: Technology for Wellbeing and Human Potential*. Cambridge, Massachusetts: The MIT Press.

Campbell, D. T., & Fiske, D. W. (1959). Convergent and discriminant validation by the multitrait-multimethod matrix. *Psychological Bulletin*, 56(2), 81. doi: http://dx.doi.org/10.1037/h0046016

Carbonara, N. (2005). Information and communication technology and geographical clusters: opportunities and spread. *Technovation*, *25*(3), 213-222

Cassavaugh, N. D., & Kramer, A. F. (2009). Transfer of computer-based training to simulated driving in older adults. *Applied Ergonomics*, 40(5), 943–952. doi: https://doi.org/10.1016/j.apergo.2009.02.001

Castells, M., & Cardoso, G. (2006). *The network society: From knowledge to policy.*

Washington, USA: Johns Hopkins Center for Transatlantic Relations Washington, DC.

Castells, M. (2001). *The Internet galaxy: Reflections on the Internet, business, and society*. Oxford, UK: Oxford University Press, Inc.

Cella, D. F. (1994). Quality of life: concepts and definition. *Journal of pain and symptom management* , 9 (3), 186-192. doi:10.1016/0885-3924(94)90129-5

Ceranoglu, T. A. (2010). Video games in psychotherapy. *Review of General Psychology*, 14(2), 141–146. https://doi.org/10.1037/a0019439

Charness, N., Czaja, S. J., Fisk, A. D., & Rogers, W. (2001). Why gerontechnology?. *Gerontechnology,* 1 (2), 85-87.

Cheyne, G. (1724). An essay of health and long life . Europeanlibraries, New York: Arno Press. Retrieved from https://archive.org/details/anessayhealthan00cheygoog (Access date: Nov 8th, 2017)

Cheong, W. L., Jung, Y., & Theng, Y.-L. (2011). Avatar: a virtual face for the elderly. In *Proceedings of the 10th International Conference on Virtual Reality Continuum and Its Applications in Industry*, New York, USA: ACM, 491–498.

Chimos, K., Bassios, M., Karvounidis, T., Kostis, I., Douligeris, C., Katsanakis, I., & Botsikas, A. (2012). Unibook SE: An innovative environment for life-long learning. In *2012 15th International Conference on Interactive Collaborative Learning (ICL)*, IEEE, Austria, 1–4. doi: 10.1109/ICL.2012.6402144

Chomsky, N. (1959). A review of BF Skinner's Verbal Behavior. *Language* , 35 (1), 26-58.

Cohen, L., Manion, L., & Morrison, K. (2013). *Research methods in education*. New York, USA: Routledge.

Connolly, T. M., Stansfield, M., & Hainey, T. (2007). An application of games-based learning within software engineering. *British Journal of Educational Technology*, 38(3), 416–428. doi: 10.1111/j.1467-8535.2007.00706.x

Cooley, C. H. (2009). Human nature and the social order. (7th ed.) Transaction Publishers. ISBN: 0-87855-918-3

Cooley, C. H., & Mead, G. H. (2006). *The social self*. Charles Horton Cooley: Imagining Social Reality, Massachusets, USA: University of Massachusetts Press.

Cooley, C. H. (1992). *Human nature and the social order*. London, UK: Transaction Publishers.

Cooper, A., Reimann, R., & Cronin, D. (2007). *About face 3: the essentials of interaction design.* Indianapolis, USA: John Wiley & Sons.

Cooper, P. A. (1993). Paradigm Shifts in Designed Instruction: From Behaviorism to Cognitivism to Constructivism. *Educational technology*, *33*(5), 12-19. Retrieved from http://www.unhas.ac.id/hasbi/LKPP/Hasbi-KBK-SOFTSKILL-UNISTAFF-SCL/Mental%20Model/Shift%20paradigm%20Behaviorism.pdf (Access date: Nov 8th, 2017)

Costa, L. & Grist, H. (2017). Ageing in a network society: An Introduction. *Networking Knowledge: Journal Of The MeCCSA Postgraduate Network, 10*(1), 1-4. Retrieved from http://ojs.meccsa.org.uk/index.php/netknow/article/view/499 (Access date: Nov 8th, 2017)

Costa, L. V., & Veloso, A. I. (2017). Demystifying Ageing Bias Through Learning. In D. Beck, C. Allison, L. Morgado, J. Pirker, F. Khosmood, J. Richter, & C. Gütl (Eds.), *Proceedings in Immersive Learning Research Network: Third International Conference, iLRN 2017*, Coimbra, Portugal, June 26--29, 2017 (pp. 201–213). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-319-60633-0_17

Costa, L. V., Veloso, A. I., & Mealha, Ó. (2017). A Review of Proxemics in `Smart Game-Playing'. In Ó. Mealha, M. Divitini, & M. Rehm (Eds.), Citizen, Territory and Technologies: Smart Learning Contexts and Practices: Proceedings of the *2nd International Conference on Smart Learning Ecosystems and Regional Development -* University of Aveiro, Portugal, 22-23, June 2017 (pp. 219–226). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-319-61322-2_22

Costa, L., & Veloso, A. (2016a). "Game-based psychotherapy" for active ageing: A game design proposal in non-game context. In *TISHW 2016 - 1st International Conference on Technology and Innovation in Sports, Health and Wellbeing, Proceedings.* https://doi.org/10.1109/TISHW.2016.7847788

Costa, L. V., & Veloso, A. I. (2016b). Factors influencing the adoption of video games in late adulthood: A survey of older adult gamers. *International Journal of Technology and Human Interaction*, 12(1). https://doi.org/10.4018/IJTHI.2016010103

Costa, L., & Veloso, A. (2016c). Being (Grand) Players: Review of Digital Games and their Potential to Enhance Intergenerational Interactions. *Journal of Intergenerational Relationships*, 14(1). https://doi.org/10.1080/15350770.2016.1138273

Costa, L., & Veloso, A. (2015). "The gamer's soul never dies: Review of digital games for an active ageing." In *Proceedings of the 2015 10th Iberian Conference on Information Systems and Technologies, Aveiro, 17-20 June 2015.*Ed. Rocha et al. USA: IEE, 2015 Doi: https://doi.org/10.1109/CISTI.2015.7170614

Costa, L. (2013). *Networked video games for older adults* [Master's Thesis] University of Aveiro, Aveiro, Portugal. Retrieved from http://ria.ua.pt/handle/10773/11326 (Access date: Nov 8th, 2017)

Costanza, C., Hart, M., Talberth, J., & Posner, S. (2009). *Beyond GDP: The Need for New Measures of Progress*. Pardee Paper No. 4, Boston: Pardee Center for the Study of the Longer-Range Future

Creswell, J. W. (2013). *Research design: Qualitative, quantitative, and mixed methods approaches*. London, UK: Sage publications.

Csikszentmihalyi, M. (1990). *Flow: The psychology of optimal experience*.New York, USA: HarperCollins

Cuddy, A. J. C., Norton, M. I., & Fiske, S. T. (2005). This old stereotype: The pervasiveness and persistence of the elderly stereotype, *Journal of Social Issues*, 61(2), 267–285.

Czaja, S. J., Sharit, J., Lee, C. C., Nair, S. N., Hernández, M. A., Arana, N., & Fu, S. H. (2013). Factors influencing use of an e-health website in a community sample of older adults. *Journal of the American Medical Informatics Association,* 20(2), 277–284. doi: 10.1136/amiajnl-2012-000876

Czaja, S. J., & Sharit, J. (2012). *Designing training and instructional programs for older adults*. Boca Raton, FL: CRC.

Damasio, A. (2003). *Looking for Spinoza: Joy,Sorrow, and the Feeling Brain. Sorrow, and the Feeling Brain*. New York, USA: Random House.

Dangour, A. D., Grundy, E. M. D., & Fletcher, A. E. (2007). *Ageing well: nutrition, health, and social interventions*. Boca Raton, FL: CRC Press.

Davenport, J., & Davenport, J. A. (1985). A chronology and analysis of the andragogy debate. *Adult Education Quarterly,* 35(3), 152-159. doi: https://doi.org/10.1177/0001848185035003004

Davidson, J. L., & Jensen, C. (2013). Participatory design with older adults: an analysis of creativity in the design of mobile healthcare applications. In *Proceedings of the 9th ACM Conference on Creativity & Cognition*, New York, USA: ACM, 114–123.

De Schutter, B., & Vanden Abeele, V. (2008). Meaningful play in elderly life.In *Annual Meeting of the International Communication Association*, Quebec, Canada. Retrieved from https://lirias.kuleuven.be/handle/123456789/270392 (Access date: Nov 8th, 2017)

Deci, E. L., & Ryan, R. M. (2002). *Handbook of self-determination research*. New York, USA: University Rochester Press.

Derboven, J., Van Gils, M., & De Grooff, D. (2012). Designing for collaboration: a study in intergenerational social game design. *Universal Access in the Information Society*, 11(1), 57–65. doi: https://doi.org/10.1007/s10209-011-0233-0

Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011). From game design elements to gamefulness: defining gamification. In *Proceedings of the 15th international academic MindTrek conference: Envisioning future media environments*, New York, USA: ACM, 9–15.

Diener, E., Suh, E. M., Lucas, R. E., & Smith, H. L. (1999). Subjective well-being: Three decades of progress. *Psychological bulletin*, 125(2), 276.

Dix, A., Finlay, J., Abowd, G. D., & Beale, R. (2004). *Human-Computer Interaction* (3rd ed.). Essex, UK: Pearson Education Limited

Djaouti, D., Alvarez, J., Jessel, J.-P., & Rampnoux, O. (2011). Origins of serious games. In M. Ma, A. Oikonomou, & L. Jain (Eds.) S*erious games and edutainment applications*, New York, USA: Springer, 25–43.

Drew, L. M., & Smith, P. K. (2002). Implications for grandparents when they lose contact with their grandchildren: Divorce, family feud, and geographical separation. *Journal of Mental Health and Aging*, 8(2), 95–120.

Drickamer, L. C. (2012). Lorenz, Konrad (1903-1989). In *Encyclopedia of the Sciences of Learning* (pp. 2077–2080). Springer. https://doi.org/10.1007/978-1-4419-1428-6

Earman, J. (1986). *A primer on determinism* (Vol. 32). NL: Springer Netherlands

Efklides, A., & Moraitou, D. (2012). *A positive psychology perspective on quality of life* (Vol. 51). Dordrecht, NL: Springer Science & Business Media.

Elias, P., Rajan, N. O., McArthur, K., & Dacso, C. C. (2013). InSpire to promote lung assessment in youth: Evolving the self-management paradigms of young people with asthma. *Medicine 2.0,* 2(1), e1. http://doi.org/10.2196/med20.2014

Ellsworth, P. C., & Scherer, K. R. (2003). Appraisal processes in emotion. In R. Davidson, K. Sherer, H. Goldsmith (Eds.) *Handbook of Affective Sciences*, Oxford, UK: Oxford University Press, p. 572-595

Fang, K., Lin, Y. C., & Chuang, T.L. (2009). Why do internet users play massively multiplayer online role-playing games? A mixed method. *Management Decision*, 47(8), 1245–1260. https://doi.org/10.1108/00251740910984523

Fayers, P., & Machin, D. (2013). *Quality of life: the assessment, analysis and interpretation of patient-reported outcomes*. New Jersey, USA: John Wiley & Sons.

Felce, D., & Perry, J. (1995). Quality of life: Its definition and measurement. *Research in developmental disabilities*, 16 (1), 51-74. doi:10.1016/0891-4222(94)00028-8

Ferreira, S. de A. (2010). Estudo qualitativo e comparativo do uso das TIC's pelo cidadão sénior. [Master's thesis] Universidade de Aveiro, Aveiro, Portugal.

Findsen, B., & Formosa, M. (2011). *Rationales for older adult learning.* In B. Findsen & M. Formosa (Eds.) *Lifelong Learning in Later Life*, 7(1) SensePublishers, 89–101. doi: 10.1007/978-94-6091-651-9

Fisk, A. D., Czaja, S. J., Rogers, W. A., Charness, N., & Sharit, J. (2009). *Designing for older adults: Principles and creative human factors approaches*. Boca Raton, FL: CRC press.

Floyd, C., Mehl, W.-M., Reisin, F.-M., Schmidt, G., & Wolf, G. (1989). Out of Scandinavia: Alternative Approaches to Software Design and System Development. *J. Human-Computer Interaction*, 253-350. doi: https://doi.org/10.1207/s15327051hci0404_1

Fonseca, I., Amado, P., & Costa, L. (2014). Desenho de interfaces para seniores: desafios e oportunidades no projeto SEDUCE. *Prisma.com*, (23), 107-138

Formosa, M. (2002). Critical gerogogy: Developing practical possibilities for critical educational gerontology. *Education and Ageing*, 17 (1), 73-86.

Foskey, R. (2001). *Technology and older people: overcoming the great divide*. Retrieved from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.199.6890&rep=rep1&type=pdf (Access date: Nov 8th, 2017)

Galbraith, J. K. (2007). *The new industrial state*. New Jersey, USA: Princeton University Press.

Gamberini, L., Barresi, G., Maier, A., & Scarpetta, F. (2008). A game a day keeps the doctor away: A short review of computer games in mental healthcare. *Journal of CyberTherapy and Rehabilitation*, 1(2), 127–145.

Gamberini, L., Martino, F. , Seraglia, B., Spagnolli, A., Fabregat, M., Ibanez, F., Alcaniz, M., & Andres, J. M. (2009). Eldergames project: An innovative mixed reality table-

top solution to preserve cognitive functions in elderly people. In *2nd Conference onHuman System Interactions*, 2009. HSI'09, 164–169. doi: 10.1109/HSI.2009.5090973

Gardner, R., Cairns, J., & Lawton, D. (2000). *Education for Values: Morals, Ethics and Citizenship in Contemporary Teaching.* Raton, FL: Psychology Press.

Gee, J. P. (2007). Good video games+ good learning. New York, USA: Peter Lang.

Gengnagel, C., Nagy, E., & Stark, R. (2015). *Rethink! Prototyping: Transdisciplinary Concepts of Prototyping*. Switzerland: Springer International Publishing. doi: 10.1007/978-3-319-24439-6

Gibson, J. J. (2015). *The ecological approach to visual perception: classic edition.* Boca Raton, FL: Psychology Press.

Githens, R. P. (2007). Older adults and e-learning: Opportunities and barriers. Q*uarterly Review of Distance Education*, 8(4), 329.

Glanz, K., Rimer, B. K., & Viswanath, K. (2008). *Health behavior and health education: theory, research, and practice*. New Jersey, USA: John Wiley & Sons.

Glaser, B. G., & Strauss, A. L. (2006). *The Discovery of Grounded Theory: Strategies for Qualitative Research.* New Jersey, USA: Transaction Publishers.

Glass, B. D., Maddox, W. T., & Love, B. C. (2013). Real-time strategy game training: emergence of a cognitive flexibility trait. *PLoS One*, 8(8), e70350.

Gleitman, H., Fridlund, A. J., & Reisberg, D. (2003). *Psicologia.* Lisboa: Fundação Calouste Gulbenkian.

Goffman, E. (2005). *Interaction ritual: Essays in face to face behavior*. New Jersey, USA: AldineTransaction.

Goh, J. O., & Park, D. C. (2009). Neuroplasticity and cognitive aging: the scaffolding theory of aging and cognition, *Restorative Neurology and Neuroscience,* 27(5), 391–403.

Goldstein, E. B. (2014). *Cognitive psychology: Connecting mind, research and everyday experience*. Wadsworth, USA: Cengage Learning.

Griffiths, M. D., Kuss, D. J., & de Gortari, A. B. O. (2013). Videogames as Therapy: A Review of the Medical and Psychological Literature. In M. Griffits et al. (Eds.) *Handbook of Research on ICTs and Management Systems for Improving Efficiency in Healthcare and Social Care*, 43-68. doi: 10.4018/978-1-4666-3990-4.ch003

Gruber, H., & Mandl, H. (2000). Instructional psychology and the gifted. In Keller et al. (Eds.) *International handbook of giftedness and talent*, 2 ed., Oxford, UK, 383-396.

Guillén-Nieto, V., & Aleson-Carbonell, M. (2012). Serious games and learning effectiveness: The case of It's a Deal! *Computers and Education*, 58(1), 435–448. https://doi.org/10.1016/j.compedu.2011.07.015

Günther, V. K., Schäfer, P., Holzner, B. J., & Kemmler, G. W. (2003). Long-term improvements in cognitive performance through computer-assisted cognitive training: a pilot study in a residential home for older people. *Aging & Mental Health*, 7(3), 200–206.doi: http://dx.doi.org/10.1080/1360786031000101175

Haegerstrom-Portnoy, G., Schneck, M. E., & Brabyn, J. A. (1999). Seeing into old age: vision function beyond acuity. *Optometry and Vision Science*, 76(3), 141–158.

Hall, E. T.(1969). *The hidden dimension*. New York, USA: Anchor Books.

Hansen-Kyle, L. (2005). A concept analysis of healthy aging. *Nursing Forum*, 40 (2), 45–57. doi: 10.1111/j.1744-6198.2005.00009.x

Harwood, J. (2007). *Understanding communication and aging: Developing knowledge and awareness*. Thousand Oaks, USA: Sage.

Harwood, J., & Lin, M.C. (2000). Affiliation, pride, exchange, and distance in grandparents' accounts of relationships with their college-aged grandchildren. *Journal of Communication*, 50(3), 31–47. doi: 10.1111/j.1460-2466.2000.tb02851.x

Hergenhahn, B., & Henley, T. (2013). *An introduction to the history of psychology*. Massachusetts, EUA: Cengage Learning.

Herrero, L. (2011). *Homo Imitans: The Art of Social Infection: Viral Change in Action*. UK: MeetingMinds

Hojjat, S., Fukuzaki, C., & Sowa, T. (2016). Game Design Combined with Science Workshop for Increasing Motivation in Studying Science in Children. *Art and Design Review*, 4(2), 41-55. doi: http://dx.doi.org/10.4236/adr.2016.42007

Holling, C. S. (2001). Understanding the complexity of economic, ecological, and social systems. *Ecosystems*, 4(5), 390–405. doi: https://doi.org/10.1007/s10021-001-0101-5

Holtzblatt, K., Wendell, J. B., & Wood, S. (2004). *Rapid Contextual Design: A How-to Guide to Key Techniques for User-Centered Design.* San Francisco, CA: Elsevier

Hookway, C. (2013). *Pragmatism. In The Stanford Encyclopedia of Philosophy*. Retrieved from https://plato.stanford.edu/entries/pragmatism/ (Access date Nov 8th, 2017)

Hudson, W. (2013). *Card sorting. The Encyclopedia of Human-Computer Interaction*, 2nd Ed. Retrieved from https://www.interaction-design.org/literature/book/the-encyclopedia-of-human-computer-interaction-2nd-ed/card-sorting (Access date Nov 8th, 2017)

Huizinga, J. (2015). *Homo Ludens*. Lisboa: Edições 70.

Hummert, M. L. (1994). Physiognomic cues to age and the activation of stereotypes of the elderly in interaction. *The International Journal of Aging and Human Development*, 39(1), 5–19. doi: https://doi.org/10.2190/6EF6-P8PF-YP6F-VPY4

Hurd, P. D. (1998). Scientific literacy: New minds for a changing world. *Science Education*, 82(3), 407–416.

Ijsselsteijn, W., Nap, H. H., de Kort, Y., & Poels, K. (2007). Digital game design for elderly users. In Proceedings of the 2007 conference on Future Play, New York: ACM, 17–22. doi: 10.1145/1328202.138206

Imel, S. (1995). *Inclusive adult learning environments.* ERIC Clearinghouse on Adult, Career, and Vocational Education, Center on Education and Training for Employment, College of Education, The Ohio State University.

Isbister, K. (2006). *Better game characters by design: A psychological approach*. San Francisco, CA: Elsevier

Jarvis, P. (1985). *Sociological perspectives on lifelong education and lifelong learning.* Athens, GA: Department of Adult Education, University of Georgia.

Johnson, S. (2006). Everything bad is good for you. New York, USA: Riverhead Books

Jordan, P. (2000). *Designing Pleasurable Products: An Introduction to the New Human Factors*. London, UK: Taylor and Francis.

Juul, J. (2012). A Casual Revolution: Reinventing Video Games and Their Players. Massachusets, USA: MIT Press.

Kalisch, H. R., Coughlin, D. R., Ballard, S. M., & Lamson, A. (2013). Old age is a part of living: Student reflections on intergenerational service-learning. *Gerontology & Geriatrics Education*, 34(1), 99–113. doi: http://dx.doi.org/10.1080/02701960.2012.753440

Kalliopuska, M. (1994). Relations of retired people and their grandchildren. *Psychological Reports*, 75(3), 1083–1088. doi: https://doi.org/10.2466/pr0.1994.75.3.1083

Kapp, K. M. (2012). *The gamification of learning and instruction: game-based methods and strategies for training and education*. New Jersey, USA:John Wiley & Sons.

Keller, J. M. (2009). Motivational design for learning and performance: The ARCS model approach. Springer Science & Business Media. doi: https://doi.org/10.1007/BF02905780

Keller, J. M. (1987). Development and use of the ARCS model of instructional design. *Journal of instructional development*, 10 (3), 2-10.

Kern, D. (2014). Conceptual Basis for Learning. In B. Schmidt-Herta, S. Krašovec, & M. Formosa (Eds.) *Learning across Generations in Europe*, Rotterdam, NL: SensePublishers.73-84.

Khan, A. M., & Lawo, M. (2016). Wearable Recognition System for Emotional States Using Physiological Devices. In *Proceedings of the 8th International Conference on eHealth, Telemedicine, and Social Medicine* (eTELEMED), 131–137.

Kirkwood, T., Bond, J., May, C., McKeith, I., & Teh, M. M. (2010). Mental capital and wellbeing through life: Future challenges. In Sahakian, J.Barbara (Ed.) *Mental capital and wellbeing* . New Jersey, USA: Wiley-Blackwell, 3-53.

Kirkwood, T.B.L, Cooper, C.L. (Eds.) (2014). *Wellbeing in Later Life . Wellbeing: A Complete Reference Guide*, 6 Volume Set. New Jersey, USA: Wiley-Blackwell.

Knowles, M. S., Holton, E. F., & Swanson, R. A. (2012). *The adult learner*. New York, USA: Routledge.

Kornhaber, A., & Woodward, K. L. (1981). *Grandparents, grandchildren: The vital connection*. New York, USA: Routledge.

Koster, R. (2013). *Theory of fun for game design*. Sebastopol, CA: O'Reilly Media, Inc.

Krans. (2012). *Serious gaming demystified* . Retrieved from https://atos.net/content/dam/global/ascent-whitepapers/ascent-whitepaper-serious-gaming-demystified.pdf (Access date: Nov 8th, 2017)

Kuittinen, M. (2011). *Learning and Teaching Computer science I like. Reports and Studies in Forestry and Natural Sciences*, no 6, pp. 137-158. Retrieved from

http://urn.fi/URN:ISBN:978-952-61-0636-6 (Access date: Nov 8th, 2017)

Lang, J. T. (1974). *Designing for human behavior: architecture and the behavioral sciences* (Vol. 6). Stroudsburg, PA: Dowden, Hutchinson & Ross, Inc.

Law, E. L. C., & Sun, X. (2012). Evaluating user experience of adaptive digital educational games with Activity Theory. *International Journal of Human-Computer Studies*, 70(7), 478–497. doi: https://doi.org/10.1016/j.ijhcs.2012.01.007

Lee, D. K. (2013). *Teacher education for democracy and social justice*. New York, USA: Routledge.

Lee, Y. Y., Chan, M. F., & Mok, E. (2010). Effectiveness of music intervention on the quality of life of older people. *Journal of advanced nursing*, 66(12), 2677-2687. doi: 10.1111/j.1365-2648.2010.05445.x

Lee, P.L., Lan, W., & Yen, T.-W. (2011). Aging successfully: A four-factor model. *Educational Gerontology*, *37*(3), 210–227. doi: http://dx.doi.org/10.1080/03601277.2010.487759

Lee, Y. (2008). Design participation tactics: the challenges and new roles for designers in the co-design process. *CoDesign*, *4*(1), 31–50. https://doi.org/10.1080/15710880701875613

Leinonen, M., Koivisto, A., Sirkka, A., & Kiili, K. (2012, October). Designing games for well-being: Exergames for elderly people. In *European Conference on Games Based Learning* (p. 635). Academic Conferences International Limited.

Lemieux, A., & Martinez, M. S. (2000). Gerontagogy beyond word: a reality. *Educational Gerontology*, 26 (5), 475 – 498. doi: http://dx.doi.org/10.1080/03601270050111887

Loos, E. (2014). Designing meaningful intergenerational digital games. In *International Conference on Communication, Media, Technology and Design*, 46-51.

Madsen, K. H., & Aiken, P. H. (1993). Experiences using cooperative interactive storyboard prototyping. *Communications of the ACM*, *36*(6), 57–64.

Maillot, P., Dommès, A., Dang, N.-T., & Vienne, F. (2017). Training the elderly in pedestrian safety: transfer effect between two virtual reality simulation devices. *Accident Analysis & Prevention*, *99*, 161–170.

Malone, T. W. (1980). What makes things fun to learn? heuristics for designing instructional computer games. In *Proceedings of the 3rd ACM SIGSMALL symposium and the first SIGPC symposium on Small systems - SIGSMALL '80*, 162–169. https://doi.org/10.1145/800088.802839

Manheimer, R.J. (2005). The older learner's journey to an ageless society: Lifelong learning on the brink of a crisis. *Journal of Transformative Education*, 3(3), 198–220. doi: https://doi.org/10.1177/1541344605276055

Marín, D. P. (2014). *Information and communications technology: in the 21st century classroom*. Berlin, Germany: Walter de Gruyter GmbH & Co KG.

Martens, A., Greenberg, J., Schimel, J., & Landau, M. J. (2004). Ageism and death: Effects of mortality salience and perceived similarity to elders on reactions to elderly people. *Personality and Social Psychology Bulletin*, *30*(12), 1524–1536. doi: 10.1177/0146167204271185

REFERENCES
GAME-BASED LEARNING FOR ACTIVE AGEING
University of Aveiro and University of Porto | PhD in Information and Communication in Digital Platforms | Liliana Costa

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Maruish, M. (2011). *User's manual for the SF36v2 Health Survey*. Lincoln, RI.

Mason, P. (2017). *Medical neurobiology*. Oxford, UK: Oxford University Press.

Mayer, R. E. (2002). Multimedia learning. *Psychology of Learning and Motivation* , vol. 41 , 85-139. doi: https://doi.org/10.1016/S0079-7421(02)80005-6

McGonigal, J. (2011). *Reality is broken: Why games make us better and how they can change the world*. London, UK: Vintage.

McGuire, F. A., Boyd, R., & James, A. (1992). *Therapeutic humor with the elderly*. Boca Raton, FL: Psychology Press.

McIntyre, A. (2008). *Participatory action research.* Thousand Oaks, CA: SAGE Publishing

McLuhan, M. (1994). *Understanding media: The extensions of man*. Massachusetts, USA: MIT press.

McNeely, E. (1991). Computer-assisted instruction and the older-adult learner. *Educational Gerontology: An International Quarterly*, *17*(3), 229–237. doi: http://dx.doi.org/10.1080/0360127910170303

Merrill, M. D. (2002). First principles of instruction. *Educational Technology Research and Development*, *50*(3), 43–59.

Mesch, G. S. (2006). Family characteristics and intergenerational conflicts over the Internet. *Information, Communication & Society*, *9*(4), 473–495. doi: http://dx.doi.org/10.1080/13691180600858705

Michie, S., Van Stralen, M. M., & West, R. (2011). The behaviour change wheel: a new method for characterising and designing behaviour change interventions. *Implementation Science*, *6*(1), 42. doi: 10.1186/1748-5908-6-42

Miller, D. S., Smith, J. G., & Muller, M. J. (1992). TelePICTIVE: computer-supported collaborative GUI design for designers with diverse expertise. In *Proceedings of the 5th annual ACM symposium on User interface software and technology*,151–160.

Moreno, R. (2004). Decreasing cognitive load for novice students: Effects of explanatory versus corrective feedback in discovery-based multimedia. *Instructional science*, *32*(1), 99-113.

Muller, M. J. (2001). Layered participatory analysis: New developments in the CARD technique. In *Proceedings of the SIGCHI conference on Human factors in computing* systems, New York, USA: ACM, 90–97. doi:10.1145/365024.365054

Muller, M. J. (2003). Participatory design: The third space in HCI. *Human-Computer Interaction Handbook*, *4235*, 1051–1068. https://doi.org/10.1145/153571.255960

Muller, M. J., Wildman, D. M., & White, E. A. (1993). Taxonomy of PD practices: A brief practitioner's guide. *Commun. ACM*, *36*(6), 26–28. Retrieved from http://echo.iat.sfu.ca/library/muller_93_PD%20_handbook.pdf (Access date: Nov. 9, 2017)

Muller, M. M. J., & Kuhn, S. (1993). Participatory design. *Communications of the ACM*, *36*(6), 24–28. https://doi.org/10.1145/153571.255960

Namioka, A., & Schuler, D. (1993). *Participatory design: Principles and practices*. Boca Raton, FL: CRC Press

Nap, H. H., De Kort, Y. A. W., & IJsselsteijn, W. A. (2009). Senior gamers: preferences, motivations and needs. *Gerontechnology*, *8*(4), 247–262. doi: http://dx.doi.org/10.4017/gt.2009.08.04.003.00

Newell, A., & Simon, H. A. (1972). Human problem solving (Vol. 104, No. 9). Englewood Cliffs, NJ: Prentice-Hall.

Ng, Y. Y., Khong, C. W., & Thwaites, H. (2012). A Review of Affective Design towards Video Games. *Procedia-Social and Behavioral Sciences*, *51*, 687–691. doi: https://doi.org/10.1016/j.sbspro.2012.08.225

Norman, D. A. (2004). *Emotional Design: Why We Love (or Hate) Everyday Things*. New York, USA: Basic Books.

Nunnally, J. C., & Bernstein, I. H. (1994). *Psychological theory*. New York, NY: MacGraw-Hill.

OECD Publishing. (2000). *Reforms for an Ageing Society*. Paris. Retrieved from http://www.oecd-ilibrary.org/social-issues-migration-health/reforms-for-an-ageing-society_9789264188198-em (Access date: Nov 8th, 2017)

Olson, D. R., & Torrance, N. (Eds.). (2009). *The Cambridge handbook of literacy*. Cambridge, UK:Cambridge University Press.

Oxford dictionaries. (2015). Interaction [Website]. Retrieved from http://www.oxforddictionaries.com/definition/english/interaction (Access date: Nov 8th, 2017)

Pannese L., Wortley D., & Ascolese A. (2016). Gamified Wellbeing for All Ages – How Technology and Gamification Can Support Physical and Mental Wellbeing in the Ageing Society. In: *Kyriacou E., Christofides S., Pattichis C. (eds) XIV Mediterranean Conference on Medical and Biological Engineering and Computing 2016. IFMBE Proceedings*, vol 57. Springer, Cham. doi: https://doi.org/10.1007/978-3-319-32703-7_246

Park, D. C., & Bischof, G. N. (2013). The aging mind: neuroplasticity in response to cognitive training. *Dialogues in Clinical Neuroscience*, 15(1), 109-119

Parker, I. C. (1994). Myth, Telecommunication and the Emerging Global Informational Order: The Political Economy of Transitions. In E. A. Comor (Ed.), The Global Political Economy of Communication: Hegemony, Telecommunication and the Information Economy (pp. 37–60). London: Palgrave Macmillan UK. https://doi.org/10.1007/978-1-349-24926-8_3

Parra, C., Andrea, V. D., & Giacomin, G. (2012). Enabling Community Participation of Senior Citizens through Participatory Design and ICT. *CIRN 2012 Community Informatics Conference: "Ideals Meet Reality,"* (November). Retrieved from http://cirn.infotech.monash.edu/assets/docs/prato2012docs/parra.pdf (Access date: Nov 8th, 2017)

Paúl, C., Ribeiro, O., & Teixeira, L. (2012). Active ageing: an empirical approach to the WHO model. *Current Gerontology and Geriatrics Research*, 2012.

REFERENCES
GAME-BASED LEARNING FOR ACTIVE AGEING
University of Aveiro and University of Porto | PhD in Information and Communication in Digital Platforms | Liliana Costa

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Peel, N., Bartlett, H., & McClure, R. (2004). Healthy ageing: how is it defined and measured? *Australasian Journal on Ageing*, 23(3), 115–119. doi: 10.1111/j.1741-6612.2004.00035.x Peterson, D. A. (1976). Educational Gerontology: The State Of The Art.Educational *Gerontology*, 1(1), 61-68.

Phillips, D. C. (2014). *Encyclopedia of educational theory and philosophy* (Vol. 1). Thousand Oaks, CA: SAGE Publications.

Picard, R. W., & Picard, R. (1997). *Affective computing* (Vol. 252). Cambridge, UK: MIT press.

Pires, A. C. S. T. (2011). Efeitos dos videojogos nas funções cognitivas da pessoa idosa [Master's Thesis]. Faculdade de Medicina da Universidade do Porto, Porto, Portugal.

Postman, N. (2011). *Technopoly: The surrender of culture to technology*. New York, USA: Vintage.

Powell, R. A., Honey, P. L., & Symbaluk, D. G. (2016). *Introduction to learning and behavior*. Massachusets, USA: Cengage Learning.

Prensky, M. (2001). *Digital game-based learning*. New York, USA: McGraw-Hill.

Pritchard, A. (2009). *Ways of learning: Learning theories and learning styles in the classroom*. New York, USA: Routledge.

Prochaska, J. O., & DiClemente, C. C. (2005). The transtheoretical approach. In J. Norcross & M. Goldfried (Eds.) Handbook of Psychotherapy Integration, Oxford, UK: Oxford University Press, 147–171.

Quivy, R., & Van Campenhoudt, L. (1998). *Manual de investigação em ciências sociais*. Lisboa, PT: Gradiva.

Raessens, J., & Goldstein, J. (2011). *Handbook of computer game studies*. Massachusets, USA: The MIT Press.

Ranzijn, R. (2010). Active ageing—Another way to oppress marginalized and disadvantaged elders? Aboriginal elders as a case study. *Journal of Health Psychology*, 15(5), 716–723. doi: https://doi.org/10.1177/1359105310368181

Rao, A. S., & Georgeff, M. P. (1995). BDI Agents: From Theory to Practice. In *Proceedings of the 1st International Conference on Multiagents Systems. ICMAS-95*. Retrieved from https://www.aaai.org/Papers/ICMAS/1995/ICMAS95-042.pdf (Access date: Nov 8th, 2017)

Resatsch, F. (2010). *Ubiquitous Computing: Developing and Evaluating Near Field Communication Applications*. Germany: Gabler Verlag. doi: 10.1007/978-3-8349-8683-2

Ribeiro, O. (2012). O envelhecimento "ativo" e os constrangimentos da sua definição. *Sociologia: Revista Da Faculdade de Letras Da Universidade Do Porto*, (2), 33–52.

Rice, M., Cheong, Y. L., Ng, J., Chua, P. H., & Theng, Y.-L. (2012). Co-creating games through intergenerational design workshops. In *Proceedings of the Designing Interactive Systems Conference*, New York, USA: ACM, 368-377 https://doi.org/10.1145/2317956.2318012

Rigby, S., & Ryan, R. M. (2011). *Glued to games: How video games draw us in and hold us spellbound*, Santa Barbara, CA: PraegeRockwell, G., & Kee, K. (2011). The leisure of serious games: A dialogue. *Game Studies*, 11 (2).

Roepke, A. M., Jaffee, S. R., Riffle, O. M., McGonigal, J., Broome, R., & Maxwell, B. (2015). Randomized controlled trial of SuperBetter, a smartphone-based/Internet-based self-help tool to reduce depressive symptoms. *Games for Health Journal*, 4(3), 235–246. doi: https://doi.org/10.1089/g4h.2014.0046

Rogoff, B., Turkanis, C. G., & Bartlett, L. (2001). *Learning together: Children and adults in a school community*. Oxford, UK: Oxford University Press.

Romeo, L. (1979). *Ecce homo! A lexicon of man*. Amsterdam, NL: John Benjamins Publishing.

Rowe, J. W., & Kahn, R. L. (1997). Successful aging. *The Gerontologist,* 37(4), 433–440. doi: https://doi.org/10.1093/geront/37.4.433

Royal Government of Bhutan (2012). The Report of the High-Level Meeting on Wellbeing and Happiness: Defining a New Economic Paradigm. New York: The Permanent Mission of the Kingdom of Bhutan to the United Nations. Thimphu: Office of the Prime Minister.

Ryff, C. D., & Keyes, C. L. M. (1995). The structure of psychological well-being revisited. *Journal of Personality and Social Psychology*, 69(4), 719. doi: http://dx.doi.org/10.1037/0022-3514.69.4.719

Ryu, M.-H., Kim, S., & Lee, E. (2009). Understanding the factors affecting online elderly user's participation in video UCC services. *Computers in Human Behavior*, 25(3), 619–632. doi: https://doi.org/10.1016/j.chb.2008.08.013

Salen, K., & Zimmerman, E. (2003). *Rules of Play: Game Design Fundamentals*. Cambridge, Massachusets: MIT Press.

Salvador, T., & Howells, K. (1998, April). Focus troupe: using drama to create common context for new product concept end-user evaluations. In *CHI 98 Cconference Summary on Human Factors in Computing Systems*, New York, USA: ACM, 251-252. doi:10.1145/286498.286734

Sanchez-Gordon, S., & Luján-Mora, S. (2013). Web accessibility of MOOCs for elderly students. In *2013 International Conference on information technology based higher education and training (ITHET)*,Turkey, Oct 10-12, 1–6. doi: 10.1109/ITHET.2013.6671024

Sanders, E. (1999). Postdesign and participatory culture. Useful & Critical: The Position of Research in Design., 9 -11September 1999, Tuusula, Finland. Retrieved from http://www.maketools.com/articles-papers/PostdesignandParticipatoryCulture_Sanders_99.pdf

Sanders, E. B. E. (2002). From user-centered to participatory design approaches. Design and the Social Sciences Making Connections, 1–8. https://doi.org/10.1201/9780203301302.ch1

Santos, S. C., & Knijnik, J. D. (2009). Motivos de adesão à prática de atividade física na vida adulta intermediária. Revista Mackenzie de Educação Física E Esporte, 5(1), 23-24

Savery, J. R., & Duffy, T. M. (1995). Problem-based learning: An instructional model and its constructivist framework. In B. Wilson (Ed.) Constructivist Learning Environments, New Jersey, USA: Educational Technology Publications.

Sayre, S., & King, C. (2010). *Entertainment and society: Influences, impacts, and innovations*. New York, USA: Routledge

Schunk, D. H. (1996). *Learning theorie*s. New Jersey , USA: Printice Hall Inc.

Senge, P. M. (2014). *The fifth discipline fieldbook: Strategies and tools for building a learning organization*. USA: CrownPublishing Group

Shaffer, D. (2008). *Social and personality development*. Massachusetts, USA: Cengage Learning.

Schmidt-Hertha, B., Krasovec, S. J., & Formosa, M. (2014). *Learning across generations in Europe: Contemporary issues in older adult education.* Rotterdam, NL: Sense Publishers. doi: https://doi.org/10.1007/978-94-6209-902-9

Schott, N. (2011). "You think you are too old to play?" *Playing games and aging, Human Movement*, 12(1), 24–30. https://doi.org/10.2478/v10038-010-0030-2

Schuller, T. (2010). Building a Strategic Framework for Lifelong Learning: Insights from" Learning through Life". *Adult Learner: The Irish Journal of Adult and Community Education*, 105, 118.

Sears, A., & Jacko, J. A. (2007). *The human-computer interaction handbook: fundamentals, evolving technologies and emerging applications*. Boca Raton, FL: CRC press.

Sharma, G. R. (2002). *Western philosophy of education*. New Delhi, India: Atlantic Publishers & Dist. Books

Sidorenko, A., & Walker, A. (2004). The Madrid International Plan of Action on Ageing: from conception to implementation. *Ageing & Society*, 24(2), 147–165. https://doi.org/10.1017/S0144686X03001661

Siemens, G. (2014). *Connectivism: A learning theory for the digital age*. Retrieved from http://er.dut.ac.za/handle/123456789/69 (Access date: Nov 8th, 2017)

Silva, A. ., & Ribeiro, F. (2002). *Das " ciências" documentais à ciência da informação: ensaio epistemológico para um novo modelo curricular.* Porto: Edições Afrontamento.

Silverman, D. (2013). *Doing qualitative research: A practical handbook* (4th ed., Vol. 7). London, UK: SAGE Publications Ltd.

Skevington, S. M., Lotfy, M., & O'Connell, K. A. (2004). *The World Health Organization's WHOQOL-BREF quality of life assessment: psychometric properties and results of the international field trial.* A report from the WHOQOL group. Quality of life Research, 13(2), 299-310. doi: https://doi.org/10.1023/B:QURE.0000018486.91360.00

Smith, C. A., & Ellsworth, P. C. (1985). Patterns of cognitive appraisal in emotion. *Journal of Personality and Social Psychology*, 48(4), 813. doi: http://dx.doi.org/10.1037/0022-3514.48.4.813

Smith, M. R., & Marx, L. (1994). *Does technology drive history?: The dilemma of technological determinism*. Cambridge, Massachusets: MIT Press.

Stelle, C., Fruhauf, C. A., Orel, N., & Landry-Meyer, L. (2010). Grandparenting in the 21st century: Issues of diversity in grandparent–grandchild relationships. J*ournal of gerontological social work*, 53 (8), 682-701.doi: 10.1080/01634372.2010.516804

Stewart, K. J. (2005). Physical activity and aging. Annals of the New York Academy of Sciences, 1055(1), 193–206. doi:10.1196/annals.1323.029

Stoltz-Loike, M., Morrell, R. W., & Loike, J. D. (2005). Usability testing of BusinessThinkingTM e-learning CD-ROMs with older adults. *Educational Gerontology*, 31(10), 765–786. doi: http://dx.doi.org/10.1080/03601270500250168

Suter, W. N. (2011). *Introduction to educational research: A critical thinking approach* (2nd ed.). Thousand Oaks, California: SAGE Publications Ltd.

Swanson, R. A., & Holton, E. F. (2001). *Foundations of human resource development.* California, USA: Berrett- Koehler Publishers.

Tajfel, H., & Turner, J. C. (1979). An integrative theory of intergroup conflict. *The Social Psychology of Intergroup Relations,* 33(47), 74.

Tizard, B., & Huges, M. (2008). *Young children learning*. New Jersey, USA: John Wiley & Sons.

Tan, C. (2014). *Confucius*. London, UK: Bloomsbury Publishing.

Tracy, S. J. (2012). *Qualitative research methods: Collecting evidence, crafting analysis, communicating impact*. Sussex, UK: John Wiley & Sons

Thwaites, T., Davis, L., & Mules, W. (2002). *Introducing cultural and media studies: a semiotic approach*. New York, USA: Palgrave.

Trommsdorff, G. (2009). Intergenerational relations and cultural transmission. In Schönpflug (Eds.) *Cultural Transmission Psychological, Developmental, Social, and Methodological Aspects*. Cambridge, UK: Cambridge University Press

Tudor, L. G., Muller, M. J., Dayton, T., & Root, R. W. (1993). A participatory design technique for high-level task analysis, critique, and redesign: The CARD method. In *Proceedings of the Human Factors and Ergonomics Society Annual Meeting* (Vol. 37, pp. 295–299). doi: https://doi.org/10.1177/154193129303700409

Tuijnman, A., & Boström, A. K. (2002). Changing notions of lifelong education and lifelong learning. *International Review of Education*, 48 (1-2), 93-110. doi: https://doi.org/10.1023/A:1015601909731

Tversky, B., Suwa, M., Agrawala, M., Hanrahan, P., Phan, D., Klingner, J., … Haymaker, J. (2003). Human behavior in design: Individuals, teams, tools. In B. Tversky et al. (Ed.) Sketches for Design and Design of Sketches, 79–86. doi: https://doi.org/10.1007/978-3-662-07811-2_9

Uhlenberg, P., & Kirby, J. B. (1998). Grandparenthood over time: Historical and demographic trends. In M. Szinovácz (Ed.) *Handbook on Grandparenthood,* London, UK: Greenwood Press, 23–39.

UNESCO. (2005). Aspects of literacy assessment. Topics and issues from the UNESCO expert meeting. Paris. Retrieved from http://unesdoc.unesco.org/images/0014/001401/140125eo.pdf (Access date: Nov 8th, 2017)

UNESCO (2011). *Creating and sustaining literate environments*. UNESCO Bangkok Asia and Pacific Regional Bureau for Education, Bangkok:Thailand. Retrieved from http://unesdoc.unesco.org/images/0021/002146/214653E.pdf (Access date: Nov 8th, 2017)

UNESCO (1997). *Adult Education – The Hamburg declaration the agenda for the future.* Fifth International Conference on Adult Education 14-18 July 1997. Retrieved from http://www.uil.unesco.org/adult-learning-and-education/international-conference-confintea/adult-education-hamburg-declaration (Access date: Nov 8th, 2017)

UN - United Nations. (1948). *Universal Declaration of Human Rights*. Retrieved from http://www.un.org/en/universal-declaration-human-rights/ (Access date: Nov 8th, 2017)

UN - United Nations (2011). *Human rights of older persons* [Report], Retrieved from http://www.ohchr.org/EN/Issues/OlderPersons/Pages/OlderPersonsIndex.aspx (Access date: Nov 8th, 2017)

UN. -United Nations. (2002a). *Political Declaration and Madrid International Plan of Action on Ageing*. Madrid, Spain. Retrieved from http://www.un.org/en/events/pastevents/pdfs/Madrid_plan.pdf (Access date: Nov 8th, 2017)

UN-United Nations. (2002b). Abuse of Older Persons: Recognizing and responding to abuse for older persons in a global context. New York, USA: World Assembly on Ageing. Retrieved from http://repository.un.org/handle/11176/238541 (Access date: Nov 8th, 2017)

UN- United Nations. (2008). Guide to the National Implementation of the Madrid International Plan of Action on Ageing. New York, USA: United Nations. Retrieved from http://www.un.org/esa/socdev/ageing/documents/papers/guide.pdf (Access date: Nov 8th, 2017)

UN- United Nations. (2009). Human Security in Theory and Practice.[Report] Retrieved from http://www.un.org/humansecurity/sites/www.un.org.humansecurity/files/human_security_in_theory_and_practice_english.pdf (Access date: Nov 8th, 2017)

UN- United Nations Population Fund (2005). *Human Right Principles*. Retrieved from http://www.unfpa.org/resources/human-rights-principles (Access date: Nov 8th, 2017)

UN - United Nations (1994). *Human Development Report 1994*. Published for the United Nations Development Programme (UNDP). New York, Oxford: Oxford University Press.

UNDP - United Nations Development Programme (1990). *Human Development Report 1990*. Published for the United Nations Development Programme (UNDP). New York, Oxford: Oxford University Press.

UNEP -United Nations Environment Programme (UNEP). *About UNEP* (n.d.). Retrieved from http://www.unep.org/about/ (Access date: Nov 8th, 2017)

Van Dyk, S., Lessenich, S., Denninger, T., & Richter, A. (2013). The many meanings of "active ageing". Confronting public discourse with older people's stories. *Recherches Sociologiques et Anthropologiques*, 44(44–1), 97–115. doi: 10.4000/rsa.932

Van Norman, K. A. (2010). *Exercise and Wellness for Older Adults: practical programming strategies.* Human Kinetics Publishers.

Van Staalduinen, J.P., & De Freitas, S. (2011). A game-based learning framework: Linking game design and learning. In M. Khine (Ed.) Learning to Play: Exploring the Future of Education with Video Games, 53, 29.

Vaz-Serra, A. (2006). *O que significa envelhecer?* In H. Firmino (Ed.), Psicogeriatria (pp. 21–33). Coimbra, PT: Edições Almedina.

Veloso, A., & Costa, L. (2015). Social network games in an ageing society: Co-designing online games with adults aged 50 and over. In 2015 10th Iberian Conference on Information Systems and Technologies, CISTI 2015. https://doi.org/10.1109/CISTI.2015.7170613

Veloso, A. I., & Costa, L. (2014). Jogos na comunidade miOne. In A.I. Veloso (Ed.), *SEDUCE Utilização da comunicação e da informação em ecologias web pelo cidadão sénior.* Porto, PT: Ed.Afrontamento

Veloso, A. I., & Costa, L. V. (2016). Heuristics for designing digital games in assistive environments: Applying the guidelines to an ageing society. In TISHW 2016 - 1st International Conference on Technology and Innovation in Sports, Health and Wellbeing, Proceedings. https://doi.org/10.1109/TISHW.2016.7847789

Veloso, A. I., Ferreira, S., Soares, C., & Costa, L. (2015). O ensino das TIC aos cidadãos seniores em Portugal. In Chibás, F. e Almeida, F. (Org.) *Gestão de projetos educativos e EAD: Um olhar IberoAmericano*. Editora ATLAS - SALTA. Brasil.

Vygotsky, L. S. (1978). *Mind and society: The development of higher mental processes*. USA: Library of Congress Cataloging in Publication Data.

W3C. (2013). *Web Design and Applications - Acessbility*.[website] Retrived from https://www.w3.org/standards/webdesign/ (Access date: Nov 8th, 2017)

Waage, J., Banerji, R., Campbell, O., Chirwa, E., Collender, G., Dieltiens, V., ... & Unterhalter, E. (2010). *The Millennium Development Goals: a cross-sectoral analysis and principles for goal setting after 2015*: Lancet and London International Development Centre Commission.The Lancet , 376 (9745), 991-1023. doi: 10.1016/S0140-6736(10)61196-8

Wahl, H.-W., & Mollenkopf, H. (2003). Impact of everyday technology in the home environment on older adults' quality of life. *Impact of Technology on Successful Aging*, 215–242.

Walker, A. (2002). A strategy for active ageing. International Social Security Review, 55(1), 121–139. doi:10.1111/1468-246X.00118

Walsh, G. (2010). *Developing DisCo: A distributed co-design, on-line tool*. HCIL-2010-18 [Report]. College Park, MD: Human-Computer Interaction Lab. Retrieved from https://pdfs.semanticscholar.org/a936/a586c411e23f0b55870c7051b1aa0bbd8bd1.pdf (Access date: Nov 8th, 2017)

Wan, H. T., & Tsai, D. J. (2014). Building a community-based cooperative e-learning platform for Taiwanese tribal elders. *Gerontechnology*, 13(2), 295. doi: 10.4017/gt.2014.13.02.096.00

Watkins, I., & Xie, B. (2014). Designing a web-based interactive eHealth literacy tutorial for an older adult-oriented intervention. *Gerontechnology*, 13(2), 303.

Watson, J. B. (1913). Psychology as the behaviorist views it. *Psychological review*, 20(2), 158. doi: http://dx.doi.org/10.1037/h0074428

Weber, M. (1978). The nature of social action. In *Weber: Selections in Translation*, Cambridge, UK: Cambridge University Press, 7–32.

Webber, S., & Johnston, B. (2000). Conceptions of information literacy: new perspectives and implications. *Journal of information science*, 26 (6), 381-397. doi:10.1177/016555150002600602

Weiner, B. (1985). An attributional theory of achievement motivation and emotion. *Psychological review*, 92 (4), 548. http://dx.doi.org/10.1037/0033-295X.92.4.548

Wendel, S. (2013). *Designing for behavior change: Applying psychology and behavioral economics*. Sebastopol, CA: O'Reilly Media, Inc.

Werbach, K., & Hunter, D. (2012). *For the win: How game thinking can revolutionize your business*. Philadelphia, USA: Wharton Digital Press.

Wertheimer, M., & Riezler, K. (1944). *Gestalt theory*. Social Research , 78-99. Retrieved from http://thenewschoolhistory.org/wp-content/uploads/2014/06/wertheimer_gestalttheory.pdf (Access date: Nov 8th, 2017)

Werner, J. M., Carlson, M., Jordan-Marsh, M., & Clark, F. (2011). Predictors of computer use in community-dwelling, ethnically diverse older adults. *Human Factors*, 53(5), 431–47. https://doi.org/10.1177/0018720811420840

Wheeler, S. (2009). Digital Tribes, Virtual Clans. In S. Wheeler (Ed.) *Connected Minds, Emerging Cultures: Cybercultures in Online Learning*, Charlotte, NC, USA: IAP, 65–75.

White, H., McConnell, E., Clipp, E., Bynum, L., Teague, C., Navas, L., … Halbrecht, H. (1999). Surfing the net in later life: A review of the literature and pilot study of computer use and quality of life. *Journal of Applied Gerontology*, 18(3), 358–378. doi: https://doi.org/10.1177/073346489901800306

Wiemeyer, J., Kliem, A. (2012). Serious games in prevention and rehabilitation-a new panacea for elderly people?, *European Review of Aging and Physical Activity*, 9 (1), 41–50. doi: https://doi.org/10.1007/s11556-011-0093-x

Withnall, A. (2009). *Improving learning in later life*. Oxon, UK: Routledge.

REFERENCES
GAME-BASED LEARNING FOR ACTIVE AGEING
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Whitlock, L. A., McLaughlin, A. C., & Allaire, J. C. (2012). Individual differences in response to cognitive training: Using a multi-modal, attentionally demanding game-based intervention for older adults. Computers in Human Behavior, 28(4), 1091–1096. doi: https://doi.org/10.1016/j.chb.2012.01.012

Wood, L. E. (1997). *User interface design: Bridging the gap from user requirements to design*.Boca Raton, FL: CRC Press.

World Health Organization. (1996). *The Heidelberg guidelines for promoting physical activity among older persons*. Copenhagen: WHO Regional Office for Europe. Retrieved from http://apps.who.int/iris/handle/10665/108545 (Access date: Nov 8th, 2017)

WHO- World Health Organization. (2002). *Active ageing: A policy framework*. Geneva: World Health Organization.

WHO-World Health Organization. (2003). *Diet, nutrition and the prevention of chronic diseases*. WHO technical report series, 1-60

World Health Organization. (2015b). *Nutrition*. World Health Organization. Retrieved from: http://www.who.int/topics/nutrition/en/ (Access date: Nov 8th, 2017)

WHO-World Health Organization. (2015a). *Physical Inactivity: A Global Public Health Problem*. Retrieved from http://www.who.int/dietphysicalactivity/factsheet_inactivity/en/ (Access date: Nov 8th, 2017)

WHO - World Health Organization (2014). *The 10 leading causes of death in the world, 2000 and 2012*. World Health Organization . Retrieved from: http://www.who.int/mediacentre/factsheets/fs310/en/ (Access date: Nov 8th, 2017)

WHOQOL Group. (1998). *Development of the World Health Organization WHOQOL-BREF quality of life assessment*. The WHOQOL Group. Psychological Medicine, 28, 551–558.

Wlodkowski, R. J., & Ginsberg, M. B. (2017). *Enhancing adult motivation to learn: A comprehensive guide for teaching all adult*s. San Francisco, CA: John Wiley & Sons.

Wong, W. L., Shen, C., Nocera, L., Carriazo, E., Tang, F., Bugga, S., … Ritterfeld, U. (2007). Serious video game effectiveness. In *ACE' 07, Proceedings of the international conference on Advances in computer entertainment technology - ACE '07*, 49-55. doi: https://doi.org/10.1145/1255047.1255057

Yang, D., & Lee, W.S. (2004). Disambiguating Music Emotion Using Software Agents. In *ISMIR* (Vol. 4), 218–223. Retrieved from http://ai2-s2-pdfs.s3.amazonaws.com/65a0/61a504a6d59e7adedd1948a8d65b85dd03c4.pdf (Access date: Nov 8th, 2017)

Yousef, A. M. F., Chatti, M. A., Schroeder, U., & Wosnitza, M. (2014). What drives a successful MOOC? An empirical examination of criteria to assure design quality of MOOCs. In *2014 IEEE 14th International Conference on Advanced Learning Technologies* (ICALT), Athens, IEEE, 44–48. doi: 10.1109/ICALT.2014.23

REFERENCES
GAME-BASED LEARNING FOR ACTIVE AGEING
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Xie, B., Druin, A., Fails, J., Massey, S., Golub, E., Franckel, S., & Schneider, K. (2012). Connecting generations: developing co-design methods for older adults and children. *Behaviour & Information Technology*, 31(4), 413–423. doi: http://dx.doi.org/10.1080/01449291003793793

Xie, B., Yeh, T., Walsh, G., Watkins, I., & Huang, M. (2012, February). Co-designing an e-health tutorial for older adults. In *iConference '12 Proceedings of the 2012 iConference*, New York, USA: ACM, 240-247. doi: https://doi.org/ 10.1145/2132176.2132207

Zheng, R. Z., Hill, R. D., & Gardner, M. K. (2012). Engaging Older Adults with Modern Technology. Engaging Older Adults with Modern Technology: Internet Use and Information Access Needs. Hershey, USA: IGI Global. doi: https://doi.org/10.4018/978-1-4666-1966-1

Zichermann, G., & Cunningham, C. (2011). *Gamification by design: Implementing game mechanics in web and mobile apps*. Sebastopol, CA: O'Reilly Media, Inc.

Zichermann, G., & Linder, J. (2013). *The gamification revolution: How leaders leverage game mechanics to crush the competition*. New York, USA: McGraw Hill Education.

Zvacek, S. M. (1991). Effective affective design. *TechTrends*, 36(1), 40–43. doi: https://doi.org/10.1007/BF02761286

APPENDIX A: CONTENTS

OF ENCLOSED CD-ROM

On the enclosed CD-ROM, the Scales and Permissions given to use them, the materials used in the co-design sessions, some of the development documentation, the Consent Form used and the Ethics approval are included. Other materials related to the Prototypes, the Participants' and Interviewee's raw data were removed due to Protection reasons.

Any questions, feel free to contact me (lilianavale@ua.pt).

Three directories are included in the root directory:

Materials > Scales and Permission, Co-Design Sessions Activities, Development Documentation, Consent Form, Ethics Approval

CV > Curriculum vitae