UNIVERSITY OF SOUTHAMPTON

Faculty of Arts and Humanities

Winchester School of Art

Designing Games for Dementia Care at Pre and Early Stages

By

Noreena Yi-Chin Liu

Thesis for the degree of Doctor of Philosophy

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ABSTRACT

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Dementia is emerging as a major public health concern. Nevertheless, it is still very challenging to the families of people who are diagnosed with dementia - especially the main carers, as the stereotype of dementia in society remains negative. Games for family carers of patients at pre- and early-stages of dementia are designed to engage people, and are valued for their educational benefits, health benefits and community enhancing merits. A conceptual framework is proposed in this thesis to help develop these types of games to support family carers of patients at pre- and early-stages of dementia. The aim of the research is to increase knowledge of health issues in order to help maintain the relationship between patients and carers, since the quality of this relationship will have an effect on both of them. By playing the games, carers can understand more about their patients to change their behaviour and thoughts so they can better support them.

The game-based methods for dementia carers include social marketing, knowledge transfer, social media connections and game involvement. The research methods used to test this hypothesis include expert interviews and games analysis. Expert interviews were conducted with a sample of professionals, including organisations and academia, to address the two main areas: carers and digital technologies. The games analysis involved using measures of the effectiveness of the game's purpose, such as games for health, games for education and social games. Metric instruments were developed to measure the game's purpose. Exploratory experiments were performed on a selection of games using experienced gaming professionals.

The game **Make a cup of tea** was designed and developed based on the framework and the exploratory experiments results. The use of **Make a cup of tea** showed improvements to the quality of life of family carers of patients at pre- and early-stages of dementia. This thesis will contribute to the research on dementia family carers through several aspects: the proposed framework will serve as a proven theoretical concept for future research; the metric instruments provide benchmarking measures for health-based games; **Make a cup of tea** educates and enlightens dementia family carers through in-game experiences. The aim of the project is to help maintain the relationship between dementia patients and their carers which heavily influences the quality of life for both parties. From the design aspect, this project aims to explore ways to design games for dementia research purposes.

Contents

List of Figures

List of Tables

Declaration of Authorship

Print name: Noreena Yi-Chin Liu

Title of thesis: Designing Games for Dementia Care at Pre and Early Stages

I declare that this thesis and the work presented in it are my own and has been generated by me as the result of my own original research.

I confirm that:

1. This work was done wholly or mainly while in candidature for a research degree at this University;
2. Where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated;
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    - Liu, Noreena, Wills, Gary and Ranchhod, Ashokkumar (2017) Games for change applications in dementia care. At *27th Alzheimer Europe Conference: Care today, cure tomorrow, Berlin, Germany. 02 - 04 Oct 2017.*
    - Liu, Noreena, Wills, Gary and Ranchhod, Ashokkumar (2018) Game for supporting dementia carers. At *GEM 2018: Games Entertainment & Media Conference 2018 (IEEE), Galway, Ireland. 15 - 17 Aug 2018.*
    - Liu, Noreena, Wills, Gary and Ranchhod, Ashokkumar (2018). Support dementia carers in game 2018 In : *EAI Endorsed Transactions on Serious Games*. 5, 16, e3.
    - Liu, Noreena, Wills, Gary and Ranchhod, Ashokkumar (2018) Advergame for dementia awareness and supporting carers. At *8th Games for Health Europe Conference, Eindhoven, Netherlands. 08 - 09 Oct 2018.*

Signed: ……

Date: ……

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- My Spanish Moya Martínez family: Jose Damian Moya; Maria Luisa Moya, especially María Moya Martínez.
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List of Definitions

Games for Change	Using digital games for social change dedicated to movements and communities of practice. The main sub-genre is serious games, alone with newsgames, education games and health games. "*Games for Change*" is also the name of the non-profit organisation which provides support, visibility, and shared resources to individuals and organisations using digital games for social change.
Advergame	Games for advertisement purposes.
Serious game	Games designed with an educational purpose beyond pure entertainment.

List of Games

A Closed World	Created to deal with queer issues. Aims to encourage players to rethink the necessities of life.
Ah-Harr	A card game that can be played in multiple ways, such as pirate plundering, parrot pinching, treasure taking and memory mastering.
American Truck	Driving simulation game where players take control of a truck and complete different missions.
Arithmanix	A card game that requires players to find the right combination of add, subtract, multiply and divide using mental arithmetic, such that their cards in hand are equal to a given number.
Aviation Empire	Enables players to develop their own airports and buy the latest aircraft and landing light in the game with the game credits.
Backpacker	A card game that discusses potential issues faced by backpackers.
Brain Training Game Demonstration	A point-and-click game to test if doing brain training games can improve cognitive function. Developed by the researchers at King's College London.
Bubble Shooter	The aim of game is to shoot down bubbles. This is a game without a defined end-point.
Cancer Game	Allows the player to explore the cancer in different organ. The game encourages the players to live in a healthier lifestyle.
Castaway	Role playing game in a mysterious island. Players have to grow their own powers and abilities.
Cortex Challenge	This card game challenges the players' brainpower and encourages intensive quick thinking and memorizing. There are eight different challenges in the game, such as touch tests, observation, analysis, mazes. coordination, etc.
Crysis3	A shooting video game released in 2013. There are various strategies to win the game, such as to craft a stealthy attack on the opponents, or to decimate the enemy with a blaze of brute force.
Darfur is Dying	This game discussed the issues of the crisis in Darfur, western Sudan about the refugees who live in the refugee camp.

Diablo	An action role-playing video game series, set in the fantasy world of Sanctuary.
Elude	The aim of this game is to raise awareness of mental health issues.
Endgame: Eurasia	This game explores news and current affairs regarding war.
Euro Truck Simulator	A vehicle simulation game series. Players only have access to their starting country at first, then explore other countries nearby.
Fiete Choice	Designed for children to train their concentration level, logical thinking and most importantly their visual perception with the help of some logic games.
FIFA	The well-known football game. The game can be played in solo or multi-player mode through competition or collaboration with other players
Fitbit	A health and fitness tracker. Players can compete among each other.
Fugue	A point-and-click game to explore a fantasy world. Player are guided by tarot cards.
Gran Turismo	A series of racing video games which is developed for PlayStation consoles.
Guitar Hero	A music rhythm game which allows player to simulate playing various musical instruments through a guitar-shaped game controller.
Gululu Interactive Water Bottle	Designed for young age kids to encourage the development of good drinking habits.
Habitat the game	Designed to educate players about how climate change affects animal species around the world.
Habbo	Social networking service for teenagers that began in 2000. Allows players to create their own virtual character and socialize with others.
Happy Farm	Develop based on farm management simulation as a social networking game and is linked with Facebook
Homeland Guantanamos	Discusses true stories relating to human rights issues such as immigrant detention in US.
Hungry Shark World	Allows players to explore the ocean depths, unlocking treasures and missions across four unique locations from the perspective of a shark.

I care… do you?	Developed by Carers Trust Swansea Bay, Wales to raise awareness of a young carers' role and the issues they faced at home and at school.
Ice flow	Discusses climate change issues
In Between	Challenges the players to solve mind-bending puzzles by manipulating the surroundings and gravity itself.
Inside the Haiti Earthquake	An online simulation that documents real life events of Haiti earthquake in 2010.
Kingdom Rush	Allows players to customize different defensive strategy to defend their kingdom.
Lego Island	Developed as an action adventure video game and has multiple levels of play to build, explore, customize, race and ultimately capture the destructive Brickster.
Let the Cat in	Raises awareness of homeless animal issues. The game donates 15% of their revenue to the Petfinder Foundation.
Life in a Spin?	Simulates real life scenarios and challenges players to find the balance between caring and everyday life.
MahJong	Often played in Eastern and South Eastern Asia with multiple variants. The game is played with 144 tiles of different characters and symbols.
Mapominoes	An educational geography game that allows players to build a map by connecting countries with a common border.
Mario Golf	A golf simulating game on a variety of Mario-themed courses.
Mario Kart 8	A kart racing video game that allows players to choose their own character and car.
Mario Tennis	Allows player to play simulated tennis game through unique control system.
Monkey Island	An adventure game with various game plot. Each game plot usually involves the mysterious Monkey Island and is impenetrable secrets.
Monopoly	A popular game that allows players to buy and trade properties as well as develop their own houses and hotels.
Mysterium	A cooperative game where one of the players plays as a murdered ghost and the others attempt to identify the suspect, location and murder weapon. Combines murder mystery and card based guessing games.

NHS Nene CCG	Allows players to self-assess whether they know where to go for treatment and advice for an injury or illness.
Olympic Games	A sport video game officially licensed by the international Olympic Committee.
Pandemic	A cooperative board game that requires all players to work together to discover cures for 4 diseases that could wipe out a region.
Pokémon GO	A reality game that allows players to locate, capture, battle and train the virtual creature Pokémon through GPS on their mobile phones.
Refugee Mario	A video game about the migrant crisis
Re-Mission	Impacts young cancer patients with psychological and behavioural outcomes associated with successful treatment through entertaining gameplay.
ResearchOut Orb	Interactive game designed for Year 9-10 student to teach wellbeing.
Robotany	A garden building game designed to demonstrate videogame AI systems.
Sea Hero Quest	A research game developed to assist dementia researchers.
SideKick Cycle	A side scrolling bike racing game.
Sims Sweatshop	Developed to increase the awareness of the appalling conditional workers by depicting their daily life and stories.
Skip a Beat Heart Rate	Allows players to track and master their heart rate.
Sonic Rush	A side scrolling 2D platform game which requires players to move quickly through levels, collecting rings and defeating enemies.
Star Wars	A video game based on Star Wars movie series.
Stressed Eric	Based on the cartoon produced by the BBC; discuss the stress encountered due to family, work, co-workers etc.
Student Survivor	Discuss the everyday life of university students and highlights the financial challenges faced by them.
Super Mario 64	This video games developed in 1996. Super Mario 64 been used to fight off Alzheimer's Disease.

Super Mario Bros.U	A side scrolling platform video game. Players are encouraged to explore the game world and try to save the Mushroom Kingdom.
Syrian Journey	Highlights the exodus of the Syrian people. Players are allowed to choose their own route to escape as a Syrian refugee.
Tank! Tank! Tank!	An action video game where players control a tank and shoot monster with ammunition.
Tantrix	A tile based abstract game with 56 different tiles containing three lines going from one edge of the tile to another. Players aim to combine the tiles to get the longest line or loop in their chosen colour.
That Dragon, Cancer	A point click adventure game based on the experience of raising a terminal cancer child.
The Coping Game	Encourage players to develop coping strategies and behaviours that support positive emotional wellbeing.
The Dysphagia Game	The game is discusses the basic knowledge of dysphagia.
Watch Dogs	An action adventure game play on various platforms such as Microsoft Windows, PlayStation, Xbox and Wii U.
Wii Sports	A sports video game developed in 2006 by Nintendo which provides a bonding experience among family members.
Win the White House	Discusses the difficulty of presidential run. Players have to manage their own presidential campaign.
Zombie Castaways	An adventure game which requires the players to turn their character into a human through a ritual.
Zombies Run!	An immersive running game. The app is able to record the distance covered, time, pace and calories burned by the players.

Chapter 1. Introduction

Across the world, there are 7.7 million new patients with dementia every year. It is a major cause of disability in older people (WHO, 2015). Dementia is a disease where the brain degenerates over a period of time. As a result, dementia can also affect cognitive abilities, such as memory, thinking, problem solving, etc. The relationship between dementia and mental health issues is complex. People with dementia might also have mental problems, such as depression, aggression, and inappropriate behaviour.

The purpose of being a carer is to support and improve the patient's quality of life, which benefits both people with dementia and their families. So far, the cause of dementia is not yet fully understood, and no cure for this disease has yet been found.

Hence, the focus of current treatment is on delaying the progression of the symptoms and reducing the impacts that these symptoms have on the quality of life of the patient (Takeuchi, et al., 2015). Most often in the research, there is a focus on activities that help dementia patients to improve their lives. However, there has not been much research undertaken to understand the issues faced by the carers of dementia patients, and there is little research on transforming attitudes in reality and educating them in dementia family care. In seeking to understand the needs of the family carers and the different ways of approaching this problematic issue, the thesis will aim to deal with dementia and its treatment from key dimensions of engagement, with a view to designing a game system to help the carers.

Social marketing has become very popular for companies and organizations (Corner & Randall, 2011, p.1005). Public social issues, such as climate change and health (Grier & Bryant, 2005, p.319), among others, have been targeted by social marketers. Using the social marketing concept to solve problems in society is an effective method (Stead, et al., 2007) . Social marketing is the use of social media to engage people in a marketing campaign because social media is a key platform for driving engagement and broadcasting information to a large number of people (Hanna, et al. 2011., p. 268).

Games as an entertainment platform can also be used to solve complex problems. The benefits of games include social, education and health benefits. Social games are also used to engage people via social media (Kirman, 2011, p.17); for instance, games on

Facebook give players an opportunity to share their experience or thoughts and discuss possible solutions to specific issues, including raising the awareness of public issues or ideas to improve their health. Games for education are a platform to educate people and are frequently used in the health sector, such as *Wii Sports* (Szilard, et al., 2012). Games for health, which tell stories to provide information and convey a particular message, are used to improve people's health in various areas. For example, issues around HIV/AIDS are explained in a game that helps people to understand the disease (Dobson & Ha, 2007, p.51). "*Life in a spin?*" is a game that depicts what the average day is like for young carers; it challenges a person's skills and encourages them to reformulate their thinking with regard to how carers manage their social life, their plans for the future, their feelings and their caring duties. Technology supports dementia patients in their journey and becomes increasingly associated with two main purposes: assistive technology for medication aids and locator devices, and information and communication, which is technology for telecare and telemedicine; and, in addition, digital gaming technology (Kenigsberg, et al., 2017).

There are various platforms which could potentially provide support for dementia family carers such as website apps, video, digital marketing platforms (Facebook, Instagram, Twitter etc.). These are focused on giving detail on information which relates to not achieving deep learning. Instead, the user should try to learn on their own through actively doing (Gee, 2016). However, gaming is capable of providing a virtual experience of dementia symptoms in order that carers can empathise with the dementia patient's situation and can acquire an understanding of their feelings (Merizzi, 2018). The benefits of digital gaming for dementia will be to promote healthy ageing and independence of living by encouraging lifelong learning and optimising mental health through physical and social stimulation (Cutler, et al., 2016).

Gamification is defined as the addition of game elements to a given situation, in order to increase a user's motivation and engagement. The concept of gamification has been researched (Hamari, et al., 2014, p.3025), and it is often used as a motivator to help increase a user's uptake of a particular product. There are many examples of this; one is that people who own fitness trackers tend to increase their amount of exercise, even competing with their friends to see how many steps they have done on a daily, weekly and monthly basis. This has a positive effect on their lives and has also increased the

uptake of this particular technology. For instance, Fitbit made $152.9 million in 2014 and $409.3 million in 2015[1].

To achieve this effect, one possible method could be using the social marketing concept through social communities platforms and collaboration with games development. Games to support dementia carers within the wide context of community engagement through social communities could be a promising avenue to increase knowledge of health issues and involvement with community support.

Dementia within its three stages requires different types of support. In pre- and early-stage dementia, patients might still function relatively independently or require little carer assistance. In the middle stage, no longer independent, they might require assistance with daily living. In the late stage of dementia patients will require 24 hour assistance. Dementia patients may be bedridden, and many families are ill-equipped to offer this level of care (Dementia Care Central, 2018). The main focus is on pre- and early-stages due to the dementia family carers' need for knowledge and social community support and for identification of dementia patients' needs so that carers can assist them in maintaining independent living (Enshaeifar S, et al., 2018).

The early stage of dementia have been misunderstood as normal parts of the aging process. Hence, patients will often delay from the best time for treatment (Milne, et al., 2018). A diagnosis of dementia also affects the whole family (Hughes, et al., 2002). They might feel guilty or embarrassed for losing their temper and not caring for a person with dementia, as they do not really understand how to help or what to do (Donaldson, et al., 1998).

Carers and family need to have patience and kindness and the ability to cope with dementia patients (Graham, et al., 1997, p.931). Misconceptions perpetuate the stigma, often leaving dementia hidden and sufferers isolated. Negative reactions from neighbours or families can lead to the emotions of hopelessness and frustration. Being a carer with ongoing responsibilities in the long term is physically and mentally

[1] http://www.bbc.co.uk/news/business-34703577, 2016. *Fitbit triples revenue on popularity of activity tracking.,* BBC

exhausting. Family carers might have to change their lifestyle (McDougall, et al., 2014, p.82), and become depressed (Robinson, et al., 2010, p.659).

The majority of research focuses on the dementia condition itself in different ways, such as medical issues, mental problems, etc. Caring for relatives with dementia causes significant frustration for carers and might also affect their own physical and psychological health. People who care for those with dementia have a wide range of experiences and face a wide spectrum of emotions at different times; these include feelings of loss, guilt, anger and embarrassment. Dementia carers need to take time to reflect upon their experiences. They also need someone to talk with in order to share their information and discuss the problems they are facing. Thus, appropriate support systems such as community care are very helpful for dementia carers (Bruce & Paterson, 2000).

1.1 Research Purpose and Questions

The research purpose is to investigate how to support dementia carers through games. This research is focus on dementia family carers, for early stage dementia. The aim is to develop and present a framework that can promotes a methodological approach. This framework will consist of components representing the carers' needs and carer support platforms.

Being diagnosed with dementia brings huge challenges for the whole family. Social marketing combined with gaming techniques may be the way in which patient's carers can be reached, educated, and perhaps achieve a positive behaviour goal (Corner & Randall, 2011).

The current research about the application of games in this area is focused on the dementia condition itself, and online techniques provide limited support for carers (Hughes, et al., 2002). In order to help dementia family carers facing their challenges, online communities through games could provide a platform to engage people. Games could demonstrate the experience of dementia symptoms, and convey information about how to support dementia as a family carer.

The main problem found is that there is not enough support for family carers of people with dementia; most of the research is centred on the dementia patients. The literature

indicated the main problems faced by dementia carers include the limited platforms and services that are available, psychological problems (e.g. feeling lonely or stressed) or carers not understanding their patients well. From those problems, three key elements can be identified: Community, Health and Education. The Community element is focused on the social issues. The Health element is focused on negative emotional issues (e.g. stress, loneliness). The Education element is about helping carers to understand dementia issues. There are four types of solutions to deal with these issues, which are social media, social marketing, communities, and games to help dementia family carers. The problems related to this are summarised in **Table 1.1**, which shows the problems dementia carers face, and how to address them through the solutions in different platforms, such as Community, Social marketing, Social media, and Games.

Table 1.1: Problems and Solutions for Dementia Carers

Problems	Solutions	Reference
There are limited platforms available to enable a carer to talk to/spend time to share their experience with other family carers.	Social media, Community	Stead, et al., 2007 R. et al.,2005
Carers do not know the services that are available to them in the community, or they cannot find a suitable service.	Social marketing, Social media	Hewer, et al., 2005 Hanna, et al., 2011
Slow uptake of some software solutions.	Game	Ksiazek, et al., 2014 Cheng & Cairns, 2005 Jang, 2004 Steinemann, et al., 2010
Carers can become challenged due to the demands of being a carer.	Social media, Community, Game	Nice, 2006 Graham, et al., 1997
Carers might come out with negative emotions, such as loneliness, frustration, or depression.	Social marketing, Community	Pfeil & Zaphiris, 2009 Kur, et al., 2010a
Carers might need counselling to help them face their personal problems.	Social media, Game	Michailidou, et al., 2014
Carers may not understand their patients very well, and do not always know the best way to help them.	Social marketing, Social media, Community	Lefebvre, 2012 Wakefield, et al., 2010 Bluestien, 2013
Communities designed specifically for dementia carers and their needs do not exist in great numbers.	Social media, Community	Hope, et al., 2014 Terlutter & Capella, 2013

The conjecture for this thesis is that ideas from dementia carer needs and games can be combined for a change platform, which could help dementia family carers to increase their knowledge of health issues. Thus, this research aim is to develop a framework of important elements for dementia carers and design a game for dementia carers according to the framework. To accomplish this, the research needs to answer two questions.

The first question is defined as:

RQ1: "What is an appropriate framework for informing and supporting carers of people with dementia?"

This framework would answer more detailed questions such as:

Q1-1: What types of social media games are most effective in reducing carer stress?

Q1-2: How can communities of dementia carers be built?

Q1-3: What are the education opportunities for carers?

In order to find out what types of games are most effective in increase the knowledge of carer health issues, the current literature was researched. The existing communities for carers were researched and compared according to the number of users and their activities. The current literature on how communities can be built was also explored. To find out what literature there was available to educate carers, a search was made using the NHS as a starting point, expanding to charities, as well as some courses available to carers to see if any existing courses provided the information which carers need.

After the framework was created based on this literature review, it was confirmed by the game analysis and expert interviews. In order to identify the important elements for dementia carers, and further refine the content of the framework, a methodology for applying the framework content needed to be established. To address this point, the second research question can be defined as:

RQ2: How can the games be used to support carers?

The sub questions are:

Q 2-1: Can games be effective in improving carers' health?

Q 2-2: Can games increase the carers' social community?

Q 2-3: Can games be used to educate carers?

The proposed framework can be used to measure the Health, Education and Social components in games. It is expected that this approach can be used to evaluate games in terms of supporting dementia carers. In order to answer the research question, a metric table was developed according to the framework, using the Goal Question Metric (GQM) method to construct measurements for testing a selection of games. The games were tested with game professionals (game designers, developers, etc.) in the industry. After tested with game industry professionals, a game was created using the framework. In order find out whether the game was successful for dementia carers, it was tested using the metric table and the dementia carers' feedback of the game.

1.2 Design of the Research Stages

This research was designed within three stages, as shown in in **Figure 1.1**, which illustrates an overview of the research. The first stage involved exploring the dementia carers' needs, and defining the platforms to support dementia carers, through undertaking a literature review from five fields: Social marketing for public health, Engagement strategies in games, Social media supporting dementia carers, Games for dementia and carers, and Dementia carers' needs. The research gap which emerged through the literature review would form the basis of the proposed framework. The framework is intended to be used to help inform and support dementia carers. Expert interviews and game analyses were conducted to confirm and refine the resulting framework. The purpose in the first section is to present an overview of the ideas, theories and significant literature currently published on the topic of dementia family carers and games in **Chapter 2**. The outcome of this stage is the discovery of the research gap relating to how dementia family carers' needs can be supported, especially in pre- and early-stages of dementia. In order to provide virtual experience, the game is the primary platform to support dementia carers in increasing their knowledge of health issues.

In the second stage, an instrument for the framework was developed and tested. The purpose of the conceptual framework is to present a description and depiction of potential support for dementia family carers though the game that illustrates the key relationships between the carers' needs and available platforms, as discussed in **Chapter 3**. The framework is confirmed by expert interview and game analysis in **Chapter 5** and **Chapter 6.1.** The purpose of the metric instrument is to measure the framework elements, presented in a development metric table within two tables. A metric table based on the framework elements and game contents is given in **Appendix E** and discussed in **Chapter 6.2.1.** A Goal-Question-Metric table for software metric appears in **Appendix F** and is discussed in **Chapter 6.3.1**.

Following the creation of the metric tables, a validation instrument was developed, which was piloted to uncover the potential flaws before undertaking the experiments referred to in **Chapter 7.1**. The purpose of the piloting is to gain clear feedback on the games chosen, testing suitable duration times, while metric questions can elicit a deeper understanding of the participants. Exploratory experiment I involved testing with experienced game professionals, and exploratory experiment II involved testing with game professionals. The purpose of the exploratory experiments was to identify the extent to which the framework content is present for dementia carers. Regarding the outcome of exploratory experiment I, the six different types of games with games purpose were discussed, which relate to framework elements that support dementia family carers, also discussed in **Chapter 7.2.1**. The outcome of exploratory experiment II is to strengthen the reliability of the metric in **Chapter 7.2.2**.

In the final stage, a mock up game, **Make a cup of tea**, was created based on the framework and previous results in exploratory experiments I and II, featuring five minigames within key information and messages for dementia carers which is discussed in **Chapter 8**. Additionally, in order to investigate how well it supports dementia carers, a mock-up of the game was shown to dementia carers to hear their feedback in experiment I, tested with the instrument metrics; experiment II investigated this further through interviews with dementia family carers. The outcome of experiment I and experiment II had positive results for the dementia family carers. The **Make a cup of tea** game was reliable in supporting dementia family carers, especially in regard to pre- and early-stage dementia. It also proved useful for dementia patients themselves in

order to assist with self-assessment and brain training, see **Chapter 9.3**. At the end of the study, in **Chapter 10** with detail of the conclusions and future work were derived from the findings and testing results of the framework, instrument and mock up game.

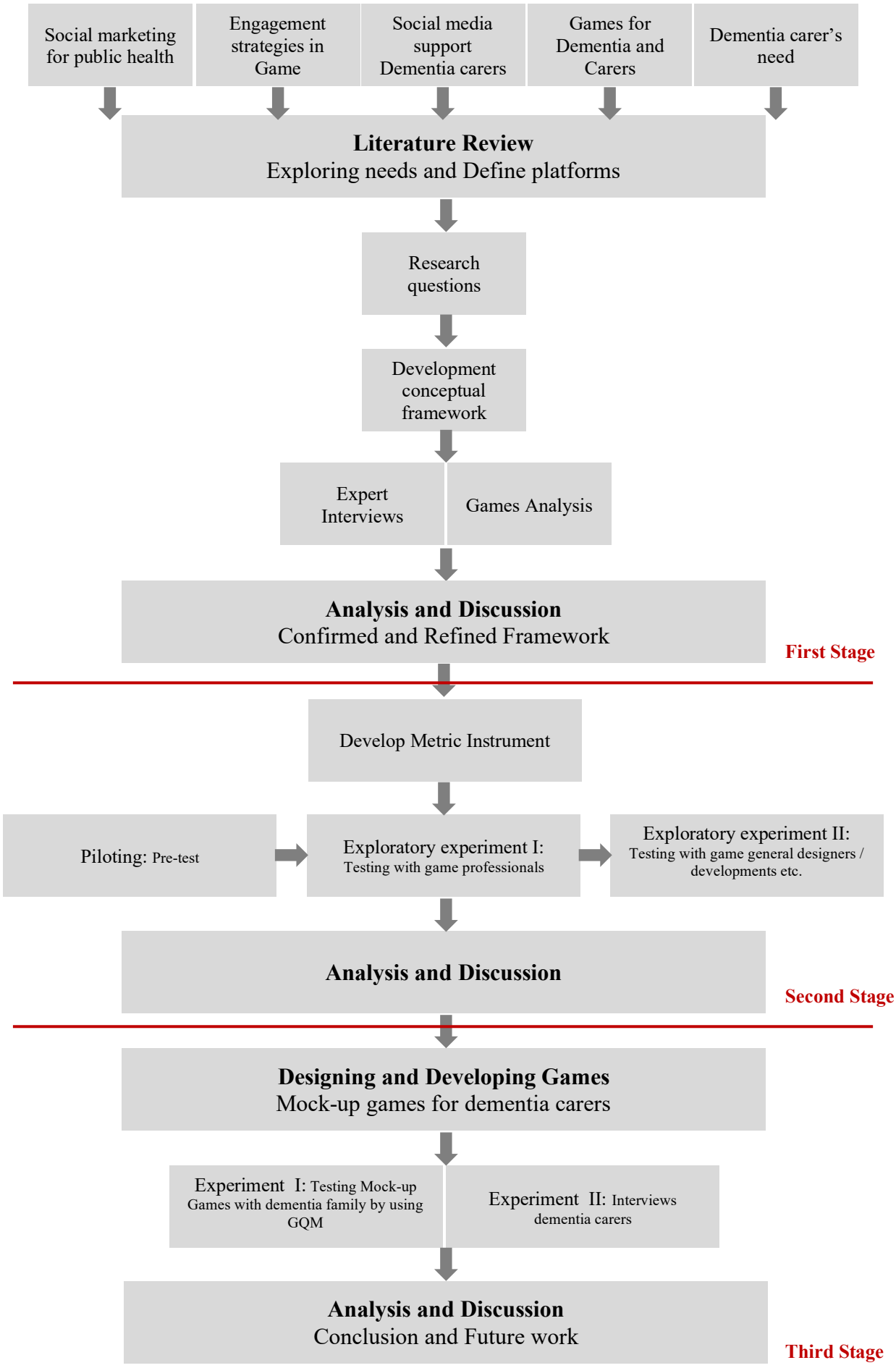

Figure 1.1: The three stages designed for the research

1.3 Research Contributions

This research opens up a new field in games, combining practical and theoretical research with a knowledge base, providing a specific, strategic innovative project that can spur on strategic research across the globe, especially in the UK. Since games can be used to solve problems and acquire new knowledge, designing an appropriate game is the first step towards providing a technological tool needed for dementia carers to increase their knowledge of health issues. The methodological benefit in this project is that games deliver knowledge for self-understanding and self-learning. The theoretical benefit shows the advances of technologies in games which contribute to social and health support via an understanding of individual case needs. The main benefit of this project is that it transforms the quality of life for individuals and communities, such as improved health and wellbeing. The results from this project can be applied to various health issues, especially long term health conditions. In the future, games platforms could be successful tools to combine with communities supporting dementia carers to educate users through self-understanding, finding the right resources and making the correct decisions in their health journey. The detailed contribution is presented in the final chapter, **Chapter 10.6**.

Additionally, the project will have an impact on a variety of users and beneficiaries outside the academic research community, though the research will focus on those related to people affected by dementia, i.e., the patients and their carers. The generic contribution to knowledge can be applied to family carers dealing with other health issues, especially mental health issues such as post-traumatic stress disorder (PTSD) and schizophrenia, as discussed in **Chapter 10.6.3.** Dementia is a decline in mental ability, the symptoms of which are similar to those of PTSD. Family carers dealing with dementia and PTSD may be facing similar problems, and ways of supporting family carers for PTSD might need to focus on enhancing knowledge of health issues and available social services (Shepherd et al., 2018).

1.4 Thesis Structure

Chapter 2: In this chapter, relevant literature was collected and reviewed to grasp the current issues in the areas of social marketing for public health, engagement strategies

in games, social media supporting dementia carers, games for dementia and carers, and dementia carers' needs.

Chapter 3: Details the development of the conceptual framework according to the **Chapter 2** literature review. In this chapter, the development process of the conceptual framework is described.

Chapter 4: In this chapter, the methodology for validating the framework is described, including the overview of the research methodology and design research methodology (which involves designing appropriate research methodology to confirm and refine the conceptual framework).

Chapter 5: This chapter confirm and refine the conceptual framework by analysis of expert interviews.

Chapter 6: This chapter describes the use of games analysis to confirm and refine the conceptual framework; validation methodology concerning the game for dementia family carers; developing the metric instrument, the piloting, the exploratory experiment, the design and development of the game, and experiments I and II; and development of the metrics to apply to the game and evaluate the framework elements.

Chapter 7: Discusses the piloting and exploratory experiments. The piloting involved finding the potential flaws in the framework before the following exploratory experiments. The exploratory experiments involved testing the '*Cancer Game'* with game professionals using the instrument introduced in **Chapter 6.2.3.**

Chapter 8: This chapter describes the mock-up design of the game, **Make a cup of tea**, according the framework and exploratory experiments for dementia family carers at pre- and early- stages.

Chapter 9: In this chapter, the experiment testing the mock-up game with dementia family carers is described. This study involved two phases; testing with the developed instrument, and interviews with dementia family carers.

Chapter 10: This final chapter shows the conclusions and future work, which includes research gap, answering the research questions, the implications and limitations, conclusions, contributions, future work and final remarks.

Chapter 2. Literature Review

This chapter elaborates an overview of existing research within five fields: Social marketing for public health, Engagement strategies in game, Social media support dementia carers, Games for dementia and carers, and Dementia carers' needs. It is focused on the potential gaps in this research.

2.1 Social marketing for public health

Social marketing is used in the marketplace or by non-profit organizations for managing social issues. It incorporates commercial marketing concepts and communication to support social change and change in personal behaviour (S Grier & Bryant, 2005, p.319)(Tuten ,2018). The idea is to understand people's behaviours by using social marketing concepts (which are related to various bodies of knowledge, including psychology, sociology, anthropology and communication theory (Stead, et al., 2007, p.127)) to achieve behaviour change for social good, collective well-being and societal value (Andreasen, 2002: 5). The most common aim is to address global health and social issues (Hewer, et al., 2005) (Tuten ,2018). The existing research for social marketing operates in public health, health communication, environment, transportation or financial and other areas (Lefebvre, 2012, p.119). It also reflects philosophical, religious, humanitarian and political perspectives.

2.1.1 The role of social marketing

Social marketing is used for promoting future awareness, in order to drive social and behavioural change (S Grier & Bryant, 2005). It can be used to address social issues and inequities as market problems or inefficiencies (Lefebvre, 2012, p.123). The process of social marketing concept involves attention, action and reaction, as follows (Lefebvre, 2012, p.123):

1. Attention: Creating conversation through social platforms to attract people's attention.
2. Action: Markets bring social action to foster sustainable change of health issues and well-being by influencing communities at the broadest level to achieve social goals or social values.

3. Reaction: Marketing strategies and tactics are adjusted to reflect people in marketplace.

2.1.2 Improving engagement and communication

The aim of social marketing is to engage with the public to achieve a behavioural goal when it is successfully applied on a community level. However, if there is not enough evidence to create a strategy for engagement, there will be limited public engagement (Corner & Randall, 2011, p.1010). Social marketing is 'transtheoretical' (Corner & Randall, 2011, p. 1007); the transtheoretical model (TTM) shows how a person transitions to a healthy life (Levit, et al., 2015). Social marketing is a concept to change people's behaviour by raising awareness and engagement in social issues (Andreasen, 2002), which is built up in conversation and creating communities to engage people. In order to achieve well-defined behaviour changes, promoting social issues is required (Corner & Randall, 2011, p.1007), which is also focused on behaviour, attitudes and beliefs.

The commercial marketing tools to manage people and change behaviour within a community are defined as social marketing. This has been successfully used in different types of health issues such as HIV, traffic accidents reduction, smoking etc; for example, in 2003, an AIDS project (TAP) promoted services and encouraged the community through an awareness campaign (R. et al., 2005). A more recent use of games used within social marketing is for the migrant crisis issue for refugees from Syria; the advergame was called *Refugee Mario*. In the game, a video shows the reality for Syrians who are crossing Europe, where the player faces problems of encountering smugglers, a treacherous sea voyage, and paying money to avoid the risk of being caught by hostile border police. People are discussing this across the world, as it is a large humanitarian crisis. This shows how advergames could help spread awareness of social issues.

2.2 Engagement strategies in Game

Engagement is a broad phenomenon about user attention and involvement with media (Brodie, et al., 2013). The amount of engagement relates to the amount of exposure. Engagement constitutes psychological and behavioural experiences (Ksiazek, et al., 2014, p.504). Marketing engagement is a marketing strategy to capture customers for

the company or brand (Brodie, et al., 2013, p.105), while social engagement is the performance of a meaningful social activity (Glass, 2006, p.606). There are three steps in the process of achieving community engagement (Bednarza, et al., 2008, p.90):

1. Prior engagement: Thought and Discussion.
2. Active and Effective engagement: Creating a community with specific objectives.
3. Reflection: Learning from the experience and rethinking about problems as outcomes.

The various forms of community engagement are with physically proximate groups and agencies (Bednarza, et al., 2008, p.91). Interactivity is one of the unique defining features of engagement with online tools (Ksiazek, et al., 2014, p.503).
Increasing interest in engagement has brought in digital technologies (Sashi, 2012, p.254), such as online services supported by web technology. Computer-mediated communication (CMC) includes social networks, such as Myspace, Facebook, YouTube and Twitter (Siriaraya, et al., 2011, p.617). Online communications are gaining more popularity and increase older people's life quality and wellbeing (Pfeil & Zaphiris, 2009, p.338) because it allows people to meet up with others who have the same situation, problems, religion, etc.

2.2.1 Games and Engagement

Games are interactive tools, which capture people's interest. There are many control devices, including more 'natural' types like the controller used by *Guitar Hero* (Bednarza, et al., 2008, p.102). Players use a guitar-shaped device with tilt sensors included, and play the game in the same way as playing a real guitar. The majority of game engagement techniques focus on the mental aspect; the mentality of games is to focus on having "fun" whilst in the act of mastering game play (Przybylski, et al., 2010, p.155).

The aim of the immersion approach is to have a conversation with the users, get the users involved in the games - immersion being an important element of games (Cheng & Cairns, 2005, p.1272). The user's level of immersion shows their degree of involvement with a particular game (Brown & Cairns, 2004, p.1298).
The three levels of immersion are:

1. Engagement: The first stage to involve users with the games.
2. Engrossment: The users become involved deeply with the game, and then become engrossed.
3. Total immersion: This is a stage of complete involvement. The most important part to know the users experience of the game.

The steps of immersion are described as "immersion then to engrossment and then to full immersion" (Cheng & Cairns, 2005).

The ease of control of a game is a barrier to moving to the next level of immersion, in Brown and Cairns' definition of engagement (Brown & Cairns, 2004). *Guitar Hero*'s controls are very easy to play so it is easier to engage new users. There are other factors which influence the ease of engagement, such as social media and social marketing.

There are games created for typically played with short-term interactions, such as waiting times and break times, players often played using tablets or smartphones (Terlutter & Capella, 2013, p.96). Advergames are on the increase in social networks. For example, Facebook, and can engage friends and families to foster teamwork or competitive links with social networks to share information with other users (Terlutter & Capella, 2013, p.96).

Social engagement is used to improve people's quality of life, especially for older disabled users (Jang, 2004, p.266), which provides a physiological and psychological impact to promote good healthy behaviours. Social engagement can enhance a person physically and emotionally, improving a person's quality of life through interpersonal relationships and participation in social activities (Jang, 2004, p.275). For older individuals, it has been observed that they tend to be less interested about being involved in activities. However, social engagement was related to life satisfaction; for example, increasing social engagement helps extend the prodromal period (an early stage of dementia) through social activities to train their brain (Saczynski, et al., 2006, p.463). This type of experience can act as a motivator for further interaction.

Games collaborations with social networks impact on the well-being and quality of life of an individual by exposing them to an online support community (Michailidou, et al., 2014, p.282). Social network games are digital games played through social networks. Social networks allow a person to interact with friends, establish relationships and

engage in teamwork or compete with other players. Playing an interactive advertising game provides an enjoyable experience which can increase learning, exploratory and participatory behaviours.

2.2.2 Are the factors of engagement different for different age groups?

There are various reasons to go online, such as online shopping, news, health information or online dating (Siriaraya, et al., 2011, p.619). The factors which compel a user to go on the internet relate to the individual's behaviour. Different age groups exhibit different online habits, which also depend on the person's personality and culture. In the UK, the culture of strong family bonds and a typical western lifestyle have resulted in people using online communication methods, as well as using the internet to buy products, such as train tickets and paying bills online (Michailidou, et al., 2014, p.282). The reasons for using a computer for social interaction are different for older and younger users. The most common reason to go on the internet for an older user is to facilitate communication and social support, such as contact with families and friends (Wagner, et al., 2010, p.873). Research from the Daily Telegraph[2] shows that '47 per cent of the over 50s believe they will use Facebook more as they grow older, it is used to keep "in touch with friends and family", in fact "81 per cent of the 3,012 demographic surveyed said that they check Facebook more than once a day"; it may be harder to introduce a new social network for older users though, with "35 per cent of the demographic claiming that they cannot be bothered with social media apart from Facebook".

2.3 Social community support dementia carers

Social services support for dementia patients and dementia carers within their social activities of daily living can help them with a sense of well-being (Ciebel, et al., 2016). Social service care can differ in method, delivery and platform. The most common is local community support and social media. The local community can help dementia patients to become involved and stay active (Heward, et al., 2017). These services can

[2] http://www.telegraph.co.uk/goodlife/11751851/Facebook-is-the-most-popular-social-network-for-the-over-50s.html, 2016. *Facebook is the most popular social network for the over 50s.,* The Telegraph

also allow caregivers a break and an opportunity to share their information, discuss their problems and support each other in order to maintain their own good health.

Social media is about engagement and communication (Hanna, et al., 2011, p.268) (Tafesse, et al.,2018); it is a fast way to spread information. The most important factors to understand for social media are the target user and what kind of information to give. To get the best result from social media, it is important to understand the environment and what users need or want (Kietzmann, et al., 2011, p.245).

Social media can improve the relationships between friends and families, but requires time to commit to it (Hope, et al., 2014). Social network sites are focused on helping people build up social contacts. Different age groups use different tools; users of social network sites tend to be younger and employ the sites to connect with friends and families (Siriaraya, et al. 2011, p.619), while older adults into technologies have different ways of undertaking intergeneration communication (Hope, et al., 2014, p.3911).

Digital media can be used in different ways to preserve a person's health by used effectively assisting to create new online communities, which improve social communication (Schäfer, 2012, p.528). In online communities, people can gain social support as in real life (Pfeil, et al., 2009, p.1140). Patients and carers can share information and experiences through online communities. Social media could contain assessment tools, which could be used to modify a user's behaviour for the better. The chosen social media platform could contain an online report and behaviour survey (Choudhury, 2013, p.49), which people with mental health issues could use to check their mental health. This is a subjective view, but it could become a common aspect of daily life (Choudhury, 2013, p.50). In addition, an online report filled in by patients could be used to help carers understand their patients more fully.

2.3.1 Social media and dementia carers

There are different ways to help dementia carers, such as psycho-education, support and information, training courses and involvement of other family numbers. (Nice, 2006, p.34). Dementia patients normally need physiotherapy and medication. Dementia patients and family carers need information about dementia and training courses to

understand how to face the issues that living with dementia brings. Dementia patients and carers might need psychological education, as well as a community to share their experiences with (Nice, 2006, p.34). Psychological education is about understanding how best to cope with a mental health condition, so that a mental health patient can live as good a life as possible. Social media through games can provide knowledge of dementia for dementia family carers.

2.3.2 What help do dementia carers currently have?

Recently, individuals have used social media to create online groups for people with dementia. However, online communities concentrate on dementia physiotherapy and mediation information; there is currently limited research and online communities specifically for helping dementia carers. CarersUK is an organization connected with the NHS, which supports carers in general. On their website[3], they have information about how to help in different ways, such as financial, practical and health. This website provides an online forum which allows carers discuss and share their information, but every account is very specific, and the forum does not provide an easy gateway for people to get advice about their precise problem. There is various information, but the information is not structured by topic in a granular enough way, which deters a user from engaging with it. It has limited professional advice for people about how to look after dementia patients. A better way would be to create online regional communities for individuals to connect with each other in a meaningful manner, focusing specifically on dementia carers. It is also possible to use games as support tools to help carers be more aware of issues related to dementia care, and to increase their knowledge of health issues.

2.4 Games for dementia and carers

Games can be used to solve complex problems and practice practical skills (Hildmann & Hirsch, 2008). Games can be a platform for education, brain training or to change a user's behaviour (Hamari, et al., 2014, p.3026). For instance, for dementia patients, there are games for training their brains. Some digital games have become social games,

[3] http://www.carersuk.org, *2016 making life better for carers.,* CarersUK

which are played and distributed on social networks (Kirman, 2011, p.17). This creates interactions with friends, establishes relationships and develops teamworking or competitiveness. The development of an interactive game as an enjoyable experience could increase learning, exploratory and participatory behaviours (Terlutter & Capella, 2013, p.106).

Games for change focus on social change with social movements and communities to raise their voices and share their thoughts; such games include newsgames, advergames, educational games and games for health issues. The larger sub-genre in games for change is the serious game genre; these are educational games in the form of entertainment. Gamification is the application of gaming elements (game mechanics and game dynamics) into a product or a service. The aim of gamification is to engage users and alter people's behaviours. Gamification has been used in different areas, such as health, education, political parties and the environment (Simões, et al., 2012, p.346). The concept of gamification uses game thinking and has elements in common with education. It can also make users more interactive (Simões, et al., 2012, p.347), and can foster the development of online communities.

2.4.1 Dementia and Carers help through games

Most of research for dementia is related to training the brain. Professor Simone Kuhn at the Max-Planck Institute of Human Development in Berlin researched the effect of video games on brain training. Kuhn used the currently existing game, *Super Mario 64* (an action-adventure game)[4]; after studying the results of playing for two months, she found that three areas of the brain had grown (prefrontal cortex, right hippocampus and cerebellum). This is further shown by the fMRI (function MRI) technology at the Dr. Adam Gazzaley laboratory at the University of California, San Francisco (Grazzaley, et al., 2005). Video games may improve brainpower in older adults, and the research shows that games can help people in the early stages of dementia. People can play racing games in order to improve attention and focus. There is a lab researching how games can improve brain attention span and memory (Weintraub, 2013). Akili Interactive Labs

[4] https://www.mpg.de/research/video-games-brain, 2016. *How video gaming can be beneficial for the brain.,* MAX-PLANCK-GESELLSCHAFT

in Boston are also creating similar games for people with ADHD (attention deficit hyperactivity disorder) and depression, as well as the healthily aging (Bluestein, 2013).

Mental health training resources provide the board game called "*I care ... do you?*". The aim of this game is to help identify young carers and increase awareness. The board game shows the different paths young carers can take. It can help children in school to understand the problems young carers face in their daily lives.

2.4.2 Behaviour Change / Perspective Change

Social media has been used for various health issues, allowing the population to directly affect individuals' behaviour (Wakefield, et al., 2010, p.1261). The most common issues include tobacco, alcohol, and illicit drugs.

Games for change involves using digital games for social change by providing support, visibility, and shared resources (Steinemann, et al., 2015, p.319). Games can also change users' thoughts and affect their behaviour. Examples of games which are about social issues include:

- *Sim's Sweatshop* - This game shows actual work in a factory environment. It shows that life in such a factory means hard work and long hours for a small amount of pay.
- *Student Survivor* - This game is about graduate students' efforts to try to find jobs. They face the problems of their health, social life, studies, and finances.
- *Darfur is Dying* - This game involves living the life of a refugee trying to find a way to survive in a camp.

These games aim to tell the world what the lives of these people are actually like. Through playing the game *Sim's Sweatshop*, players might change their thoughts about buying cheap clothes. Whilst playing *Darfur is Dying*, people might decide to donate food or money to refugees.

2.5 Dementia carer's needs

Dementia comes in different types, such as Alzheimer's disease, Vascular dementia. Parkinson's disease, Dementia with Lewy bodies, Frontotemporal dementia and Creutzfeldt-Jakob disease. Alzheimer's disease is the most common type of dementia.

People with dementia might with more than two types of symptoms are described as having mixed dementia (Bodea, et al., 2015). The dementia care research in this section is comprised of the key research about dementia and carers, as well as analyses of the organizations which currently exist for dementia and carers. According to the World Alzheimer's Report 2018, 34% of family carers are aged 65 or over. Most dementia carers are women, approximately two-thirds (Alzheimer's & Dementia, 2018). Forty percent of dementia family carers have a college degree or higher education. The main support for early-stage dementia patients is focused on emotional and social benefits, engaging in activities that are particularly meaningful to the both dementia patients and family carers, education and support programs which also facilitate relationships with others who are living with dementia (Alzheimer's & Dementia, 2018). Due to the fact that the game design target group comprises target group comprises people aged 65 and over , understanding older adult challenges is necessary, for example, older adults tend to experience feelings of frustration when using new technologies. However, technology for older adults should avoid being overly clunky or unfashionable (Lewis, et al., 2017).

2.5.1 Research for dementia carers

Community services are a main support for carers, as they help people share information and talk to people who share the same problems. "Carer burden" describes the carers' physical, mental, social and financial wellbeing.

2.5.1.1 Carers' knowledge of dementia, their coping strategies and morbidity

This research looks at how a carer's knowledge affects the physical and psychiatric health of the carer. The research assesses four attributes of the carer:

- The carer's psychiatric health.
- The carer's physical health
- The carer's stress and stress scale
- The carer's level of knowledge of dementia.

The research conducted by Graham in 1997 comprised of interviews with a sample size of 109 carers who were all over 65 years old. There was a correlation between a high level of knowledge in dementia and a low chance of depression. The research suggests

that if a carer is educated about dementia and understands more, they will experience less stress and a lower rate of physical and psychological morbidity (Graham, et al., 1997).

2.5.1.2 Brief evaluation of an educational program for dementia carers: The AENES study

The AENES study is a European Network for the Evaluation of Alzheimer Support groups. The invention was developed and evaluated an educational program used by the Deutsche Alzheimer Gesellschaft (German Alzheimer's Association, GAA). The study evaluated what factors affected the carer's mood and quality of life. The research showed that a carer's mental health is not only affected by their education, but also their behaviour management and coping skills (Kur, et al., 2010). Educating a carer in dementia is not enough; the educational impact is to transfer skills which can be used in an everyday context. Intervention is not focused on education alone, but also includes information on managing their behaviour and coping strategies (Kurz, et al., 2010).

2.5.1.3 Effectiveness of computer-mediated interventions for informal carers of people with dementia - A systematic review

One piece of research by McKechnie (McKechnie, et al., 2014) was about trying to help people with dementia through computer-mediated interventions, using media such as DVDs, CD-ROMs, the internet and computer programs. The interventions were psychologically-based, in the form of therapy, professional support, education or information programmes. The research focused on sessions about the patient's mood and mental health, the carer's physical health and health behaviours, and the carer's social support. The program measured the impact, composite measures and positive aspects of caregiving. The results of the research found positive effects of interventions; in particular, interventions which gave the carer self-efficacy through stress and depression.

2.5.1.4 Cognitive reframing for carers of people with dementia

Vernooij-Dassen conducted research focused on how family carers are affected by dementia (Vernooij-Dassen, et al., 2011). The outcomes were divided into the

psychological morbidity and distress of the family carers, quality of life for the carers, and their role performance and healthcare utilisation. This research showed evidence in helping carers to overcome their psychological morbidity such as anxiety, depression and stress.

2.5.1.5 Summary

Table 2.1 shows the areas the research focused on: Dementia, Carers, Interventions, Education and Psychiatric Care. The sources were chosen as they focused on the interventions made by carers, especially dementia carers, in order to understand what the needs of dementia patients and carers are and what interventions already exist. The literature summarised in the following chapter from **Chapter 2.5.1.1** to **Chapter 2.5.1.4**.

Table 2.1: Analysis of the research in Dementia and Carer support

Chapter	Research	Dementia	Carers	Interventions	Education	Psychiatric Care
2.5.1.1	Graham, et al., 1997	~~✓~~	✓	✗	✓	✓
2.5.1.2	Kurz, et al., 2010	✓	✓	✓	✓	✓
2.5.1.3	McKechnie, et al., 2014	~~✓~~	✓	✓	~~✓~~	✓
2.5.1.4	Vernooij-Dassen, et al., 2011	~~✓~~	✓	✗	✗	✓

*✓:Most discussion, ~~✓~~:Related discussion, ✗:Non discussion

2.5.2 Existing items for dementia patients and their carers

Currently there are communities, societies, organizations and charities to help sufferers of dementia and their carers; there are also websites to help these groups of people.

2.5.2.1 Alzheimer's Society (Leading the fight against dementia)

The Alzheimer's Society's website gives information about dementia and carers. The website is comprised of four main parts:

- Living with dementia - Information about what it is like to have dementia. It also explains about support networks that are available, such as "Helpline" and "Never", which is connected with a local town or city and lists services and support groups.

- Caring for a person with dementia - How to look after a dementia patient's health, aid them with their dressing, washing, eating and drinking, while also working on the difficult relationship between the dementia patient and their family and how to cope with caring.
- Get involved - How to help the society, including volunteering/donations, research, etc.
- Future information - Contacting the Helpline, Library, Annual report, Useful websites, etc.

The Alzheimer Society, which connects the user with local people socially, allows the user to easily get together with people, share information and talk with someone. On the Alzheimer's Society page, it gives a lot of information for dementia patients and carers, but there is still missing information for carers such as how to cope with caring although give the dementia helpline though. On this website, they also share a lot of social media links such as Facebook, Twitter and YouTube, giving a lot of videos and information about dementia patients and carers and what they have been doing socially. However, they do not have a space to share their own ideas or allow online chatting, and the videos do not give much detailed information which is pertinent for carers.[5]

2.5.2.2 Dementia Friends (An Alzheimer's Society initiative)

Dementia Friends is connected with the website of the Alzheimer's Society. This website showcases a programme which aims to change people's perceptions of dementia. This programme tries to get people involved in the cause. The website gives basic information about dementia, and there are sessions to help people become part of dementia friends in different cities. The sessions include understanding dementia, how to help people living with dementia in their community, instructions for in house equipment, etc. This website does not have an online community, and there is not enough information about how to deal with dementia. However, they do have personal accounts given by carers, which are a way to share information about how other people

[5] https://www.alzheimers.org.uk, 2016. *United Against Dementia.,* Alzheimer's Society.

have coped with being a carer. Dementia Friends build up various events though local communities, such as singing for brain, dementia café, etc.

2.5.2.3 Dementia

The Dementia website gives information for dementia patients and their carers, as well as family telephone numbers. It contains a lot of information about the condition of dementia and tells the user how to cope with dementia. There are a large number tips for those affected by dementia, such as how to ensure their physical health doesn't suffer, how to join a dementia support group and how to keep the lines of communication open. The website gives a large amount information for dementia and carers, and provide links about how other countries in the world support dementia patients and carers. However, the website does not have community features and is not focused on the carers.[6]

2.5.2.4 Age UK (Love Later Life)

This site is a charity, which helps people in later life within the UK. This site gives information about the different problems an older adult may face. While the site has information about dementia, it is just one of the issues they support. Most of the website concentrates about explaining the purpose of the charity, describing who they are and how to make a donation. As a result, the website does not have information about dementia carers and they do not connect with any online communities.[7]

2.5.2.5 Sunrise (Senior Living)

Sunrise is a charity focused on care homes in various places in the UK. On the website, they give information about care homes and the events or activities they have. They connect with Dementia Friends to support carers, and have coffee-time meetings for dementia patients and carers to share information and events in their lives. This website

[6] http://www.dementia.com/index.html, 2016., Dementia.
[7] http://www.ageuk.org.uk/health-wellbeing/conditions-illnesses/dementia/what-is-dementia/, 2016. *Love later life.,* AgeUK.

is more for the family carers, but they do not have an online community or enough information for carers to share their experiences.[8]

2.5.2.6 Carers in Southampton (Empowering the Silent Army)

This site gives various pieces of information for carers who are living in the city, including group support, helplines, drop-ins, training and advocacy. All the information relates to the needs of carers and solving any issues they may have. The website gives information about communities which carers can join to talk about over a cup of tea. It gives details about support services for families, who are affected by dementia and carers. The Sanctuary dementia support group features a memory café, mental health support group, etc. There is a huge amount of information for carers, but the information is focused on general carers, rather than dementia carers specifically. There also is no online community.[9] This is similar to Carers UK, which covers England, Northern Ireland, Wales and Scotland.

2.5.2.7 Summary

These six organisations are analysed in **Table 2.2**. The six organizations that the websites belong to were chosen because they offer support for dementia carers based in Hampshire.

Table 2.2: Analysis of the existing support websites for dementia carers

Chapter	Organization	Dementia Information	Carers Information	Local Community	Online community
2.5.2.1	Alzheimer's Society	✓	✓	✓	✗
2.5.2.2	Dementia Friends	✓	✓	✓	✗
2.5.2.3	Dementia	✓	~~✓~~	✗	✗
2.5.2.4	Age UK	~~✓~~	✗	✗	✗
2.5.2.5	Sunrise	~~✓~~	✓	✓	✗
2.5.2.6	Carers in Southampton	✗	✓	✓	✗

***✓:Most discussion, ~~✓~~:Related discussion, ✗:Non discussion**

[8] http://www.sunrise-care.co.uk/care-and-support-services/dementia-care.aspx, 2016. *Senior living.,* Sunrise.
[9] http://carersinsouthampton.co.uk, 2016. *Empowering the silent army.,* Carer In Southampton.

2.6 Game Design

By inviting players to visit affinity spaces or interest driven groups on the internet and discuss game involvement, the games encourage social interaction. Designing such games is not so simple as it requires greater consideration of how to appeal to the target audience and maintain their interest. Prior theories surrounding serious games were largely too disparate, and treatment of engagement and learning within such games viewed only through the lens of one particular field.

2.6.1 Game Principles

Professor James Paul Gee proposed a set of principles for designing a successful learning game with three categories: empowered learners, problem solving, and understanding (Gee, 2016).

Empowered learners are motivated to complete tasks, the impact of which can include principles such as co-designing, customising, forming identity and manipulating. With these principles, the player is able to control games, through co-design and customisation such as making their own decisions so that strategies will affect outcome. The future emphasis is on the player trying on a new identity with new skills, goals and possibilities, to manipulation of objects in the game world, becoming truly involved in the game.

The first design consideration was the state of play which delivers information for the player through a platform (Ellis, 2018). The player receives the information and gives instructions to the platform, as shown in **Figure 2.1**. A similar technology is used in industry; the organisation Ogilvy One, for example, is focused on customer engagement with one-to-one communication, which means building communication between user and platform (Carroll, 1997).

This involves:

1. Understanding and empathising between users.
2. Empathising and comprehending their needs.
3. Achieving actual behaviour to improve the quality and value of the user experience.

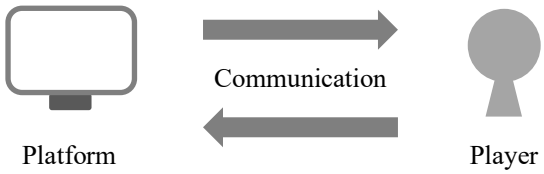

Figure 2.1: State of play

Problem solving was discussed in terms of seven principles. First, well-ordered problems guiding the player in the early stage on to form strategies that will help the player face challenges later in the game. The concept of Pleasantly Frustrating is discussed, relating to the fact that learning in human beings is at its optimum when it is pleasantly frustrating, also known as a phenomena called “flow”. The psychologist Csikzentmihalyi describes “flow” as the state of an optimal immersive experience (Csikzentmihalyi,1990), where a person is engaged in an activity that challenges them, but not to a frustratingly difficult extent. Thus, to designing games for players to enter a flow state, the game’s challenge must match player’s ability. The game design expert Ellis Bartholomeus discussed similarly that when designing games, you have to balance the challenge and player ability (Ellis, 2018). Cycle of Experience is focused on players learning through practicing, gaining experience and mastery of skills. Information ‘on demand’ and ‘just in time’ is providing information when the players feel they need it. Fish tanks and Sandboxes are for providing simpler tutorial levels to ensure the players understand the basic game rules and expanded tutorial levels that play like the actual game but without the pressure of failure, encouraging exploration and trying things out. Finally, in Skills as Strategies, the players use the skills they acquire in context in order to accomplish a goal that they desire.

The final category reveals a deep understanding within two principles, system thinking and meaning as action image, which is discussed in terms of how to create an understanding that lasts a lifetime and can lead to and prepare you for the future. System thinking refers to having the players understand how each element of the game fits into the larger genre. Meaning as action image is using the players experience with other games to convey meanings and message.

A good example of an exciting professional game industry is BBC Bitesize [10] which provides study support for students within three groups: primary, secondary and post-16. BBC Bitesize is an educational game using good learning games principles to achieve their challenge including getting more players involved and maintaining players' interest. Another example, Focus Games[11], developed various board games and online games relating to different health issues for education and training. These games encourage players to explore new ideas, increase their knowledge and help each other.

2.6.2 Designing the skills and challenges

The relationship between challenge and skills in games is illustrated in **Figure 2.2.** The Level of Skills include competition with other players or with themselves. The Level of Challenges include strategies involved in playing the game.

The Levels of Skills and Challenge have four possibilities:

- Low skills with High Challenge: Games with low competition but requiring high level strategies to play the game. For example, see the game testing with the experienced experts in **Chapter 7.2.1** where the game *The Life in Spain* was discussed, which requires strategies to balance their life as a family carer.
- High skills with High Challenge: Both competition and strategies are high level which makes the games difficult to master. This type of game is suitable for serious games for teens to challenge themselves and compete with each other as an activity that mimics exam conditions; for example, the game discussed in **Chapter 6.1,** *ReachOut Orb* which is for students to improve their knowledge of health. The player can challenge themselves or other classmates.
- High Skills with Low Challenge: High competition games with low strategies. Based on the game discussed in **Chapter 6.1.** *Pokémon Go*, for example, has a social component to challenge other players.
- Low Skills with Low Challenge: Low competition and strategies. However, the game might provide meaning, such as *The Stressed Eric,* which was discussed

[10] https://www.bbc.com/bitesize, BBC Bitesize.
[11] https://shop.focusgames.com, Focus Games.

in the game analysis in **Chapter 6.1**. This game represents emotions in various situations. Winning the game depends on luck.

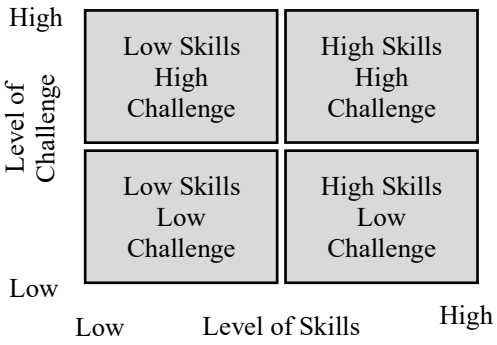

Figure 2.2: Level of skills and challenge

The design of a game should balance skills and challenge; low skills and challenge can lack excitement; low skills with high challenge might evoke negative emotions such as depression and anxiety. Conversely, high skills with low challenge games are relaxing game environments, however, the player could feel bored; high skills with high challenge could lead to loss of control as well as loss of interest. The related subjects are discussed in the game flow in **Chapter 2.6.1**. This section discusses designing games involved with the theory of game flow. This situation means designing the game to build up skills and challenge smoothly, training players' brains while at the same time giving the player space to breathe (see **Figure 2.3**).

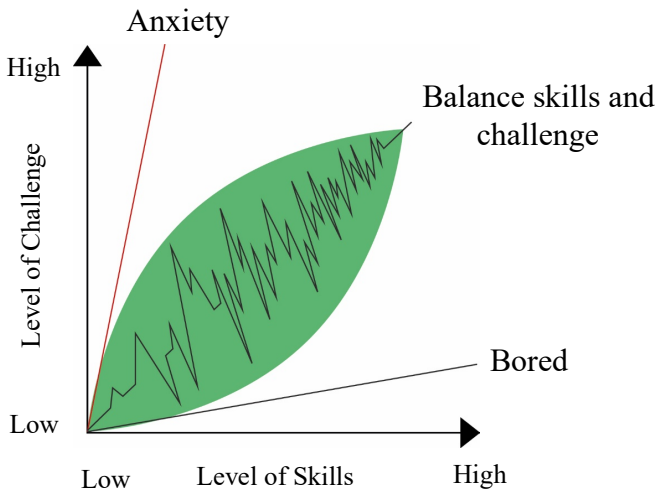

Figure 2.3: Game design skills and challenge model (Csikzentmihalyi,1990)

2.6.3 Designing game play's motivation

The design of the motivation of the game play with three stage to play within before, during and after (Ellis, 2018), is shown in **Figure 2.4**. For the first stage, the game needs to **engage** players to play; the player might initially start to interact with games involuntarily. For the second stage, once the player is playing the game, they start to explore game **experience**, referring to players' emotions and attitudes. Finally, the game players might have become intrigued as a result of exploration of the game, this immersive element is the **goals** of the game. Motivation in games play is similar to a social marketing approach (Lefebvre, 2012, p.123) and to the games strategies in (Bednarza, et al., 2008) discussed in **Chapter 3.1.3**.

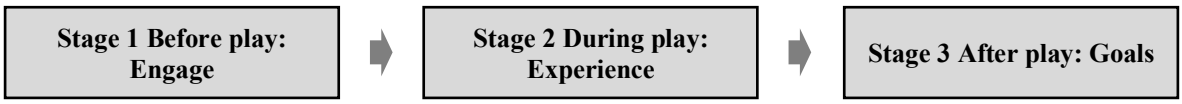

Figure 2.4: Designing game player's motivation

The game is an entertainment tool to interest players in specific issues and solve problems. The aim is to convey the real-life value of the game, encourage understanding of the context, to discover connections between players and influences to increase the creativity and affect positive change. The game not only affects its players but also affects the people around them. There is a large number of potential players; for example, games can be played in the social area alongside people who might not join in the playing but are involved in the environment. During games playing, players receive the experience with positive and negative emotions. However, negative emotions are not always negative; they might encourage players to challenge and enhance their success in games. The point is that gaming makes the social context of play stronger and more meaningful. The games contain both short-term and long-term goals. The short-term goals are satisfaction with the game, and long-term goals are about keeping the player playing the game and discussing the issues which immerse them in the game.

2.7 Chapter Summary

This chapter summarised the related work for two purposes; the first was to identify digital platforms for dementia care support, and the second was to identify dementia carers' needs. The ideal goal is to spread dementia carer support worldwide by integrating it with social marketing, social media and games. The adoption of social marketing concepts through applied social media would translate engagement into real action. Additionally, games can fulfil different purpose for dementia carers.

Caring for people with dementia poses many challenges for family carers, especially in the pre- or early-stages, because families might not have the needed knowledge of dementia, or they might not find suitable support for themselves and their dementia patient. According to the research journals, family carers need to be supported in their psychiatric health through knowledge of the health issues and their emotional state. The majority of organised community events, societies and organizations are focused on the patients and have limited items for carers, especially in terms of online technology support. Games as a platform with a unique feature to support dementia family carers, providing virtual experience in order to deliver knowledge of health issues (Merizzi, 2018). With this in mind, the next chapter describes the development of a conceptual framework to help understand, define and measure of dementia carer needs, with the knowledge of health issues and social support by digital platforms.

Chapter 3. Development of the Conceptual Framework

The previous chapter identified the concepts and relationships between carers' needs and online platforms research. This chapter presents the development process of a conceptual framework for dementia family carers based on the research gap. From the literature review, it is found that there is a lack of support for dementia carers.

3.1 Framework Development Process

The framework development comprised of four steps, as shown in **Figure 3.1**. The first step was to summarise and list all the elements derived from the existing literature, as well as defining the main elements. The second step was to group the elements into dementia patients' and carers' needs, according to which ones relate to the needs of dementia carers and dementia carers. The third step was to group the elements of the platform to support dementia carers; this stage discusses how to apply online platforms in order to support dementia carers. The final stage was to construct the framework according to the dementia carers' needs and digital platforms.

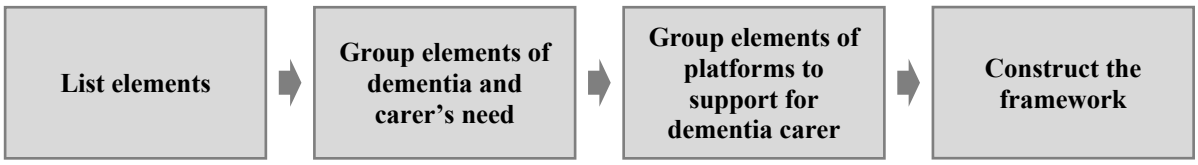

Figure 3.1: Development process of the framework

3.1.1 List elements

The elements in the diagram were arrived upon by analysing the elements in each research area from the existing literature, including carers' needs, education, health, social, engagement, games for change, social marketing, social media and games. The elements from the literature are listed in **Table 3.12**. This research is focused on support dementia family carers at pre- or early-stages. In order to support dementia carers, engagement is main strategy to attract user's attention and involved. Additionally, games for change are used to engage people though digital platforms.

Table 3.1: Elements of the Framework

Elements	Existing literature	Reference
Carers' needs	The purpose of my research is support dementia family carers, as being diagnosed with dementia brings huge challenges for the whole family, especially for the family carer. However, there is not much available support for dementia family carers.	Takeuchi, et al., 2015 Hughes, et al., 2002 McDougall, et al., 2014
Education	Based on the literature, dementia carers can at times fail to receive enough information or the right support. Dementia carers' lack of knowledge can lead to failure to make the best choices in caring for their patients.	Dobson & Ha, 2007 Graham, et al., 1997 Nice, 2012
Health	Following on from education, the dementia carers' knowledge of health issues and suggestion of being carers.	Robinson, et al. 2010 Bluestein, 2013 Choudhury, 2013
Social	Social platforms include online and local communities to support dementia carers in various aspects. Social marketing, social media and games as online social platforms should be used to get people's attention.	Wagner, et al., 2010 Steinemann, et al., 2015 Bruce & Paterson, 2000
Engagement	Engagement is the main strategy to get users' attention and involvement by different platforms.	Brodie, et al., 2013 Ksiazek, et al., 2014 Glass, 2006 Bednarza, et al., 2008 Sashi, 2012 Pfeil & Zaphiris, 2009 Jang, 2004b
Games for Changes	Games for change are dedicated digital games with different purposes. They are focused on social change, and include other sub-genres, such as serious games, newsgames, advergames and educational games.	Przybylski, et al., 2010 Brown & Cairns, 2004b Wakefield, et al., 2010 Bluestein, 2013

Social marketing	According to the literature, the conjecture of the social marketing concept is to increase people's awareness and behavior change by increase their engagement.	S Grier & Bryant, 2005 Hewer, et al., 2005b Stead et al., 2007 Lefebvre, 2012 Corner & Randall, 2011 Andreasen, 2002
Social media	The literature review explains the need to engage and communicate using social media; the communication between users leads to communities being formed.	Zunzunegui, et al., 2003 Jang, 2004b Michailidou, et al., 2014b Hanna, et al., 2011 Kietzmann et al., 2011 Choudhury, 2013
Game	Games are entertainment platform to engage players. It can be designed with different purposes, such as educational, exercise-related, etc.	Kirman, 2011 Terlutter & Capella, 2013 Hildmann & Hirsch, 2008 Simões et al., 2013

3.1.2 Group elements of Dementia carers' needs

By examining the literature, it can be seen that dementia patients and dementia carers can affect each other in physical and psychological ways. Dementia patients' treatments are focused on physiotherapy and medication. However, dementia patients and carers need support from different areas, such as by increasing their knowledge of health and increasing their daily life support from family and society (shown in **Figure 3.2**).

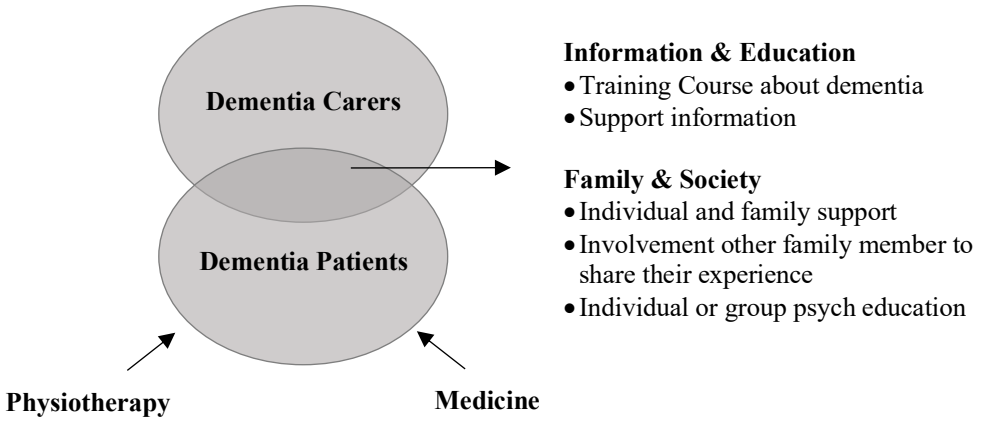

Figure 3.2: Relationship between dementia patients and dementia carers

The needs of the carers include understanding dementia, increasing knowledge of health issues and increasing social community support. Caring for people with dementia in the pre- or early-stages requires information to understand dementia and how to supporting a person with dementia; social communities are needed to provide this information and psychological support.

3.1.3 Group elements of platforms to provide support for Dementia carers

According to the literature review, the concept of social marketing is designed to engage people in order to influence behaviour or increase their community size by using social media as a communication platform to get people interested and to create the conversation around an issue, in order to transform engagement into real life action. The games platform provides an entertainment environment to achieve these different purposes and lead to engagement with users. This is exemplified by the immersion approach discussed in **Chapter 2.2.1** ; its first level is engagement, which is all about involving users in the game. Games for change are digital games focused on social change for movements and communities to share their ideas. The sub-genres of games for change include educational games, advergames, newsgames, and especially serious games.

Based on the review in **Chapter 2.1.1**, the social marketing approach has three steps. The first step involves using social media platforms to interact with people and attract them to the conversation. After getting people's attention, the next step involves influencing communities and marketplaces to achieve the broadest level of social change. Finally, the platforms are adjusted to reflect the people in marketplace, in accordance with customers and users to create changes. The discussion in **Chapter 2.2** explores game engagement strategies, including three steps. Firstly, prior engagement is used to bring thought and discussion. Secondly, active and effective engagement is created in a community with specific objectives. Thirdly, use the community's experiences to rethink the problems as learning outcomes.

The process and strategies with social marketing through social media with games is shown in **Figure 3.3**. In the first step, the aim of social marketing and games is to create

the conversation about a social issue by engaging people though different social platforms, such as social media or games. In the second step, both social marketing and games are used to increase the community size for specific objectives to achieve the broadest level of social change. The third step is to adjust the marketing and platforms according to the customers and users needs to reflect the marketplace, as with commercial purposes in social marketing. In non-profit organizations, the objective is to raise awareness of social issues to change people's thoughts or behaviours. Additionally, the purpose for games in this step is to rethink the problems from player's experience.

Step	One	Two	Three
Social Marketing approach	Attention	Action	Reaction
Engagement strategies in Games	Prior	Active and Effective	Reflection

Figure 3.3: Comparing the social marketing approach and games engagement strategies

A practical application of social marketing theory involves developing games, as shown in **Figure 3.4**. The framework's approach to social marketing is based on the theory of social marketing from **Chapter 2.1.1**, which is about engagement for the marketplace or social impact. This research is focused on supporting dementia family carers by using games as platforms, as the purpose of games for change is focused on social change as well as education, health and social interaction.

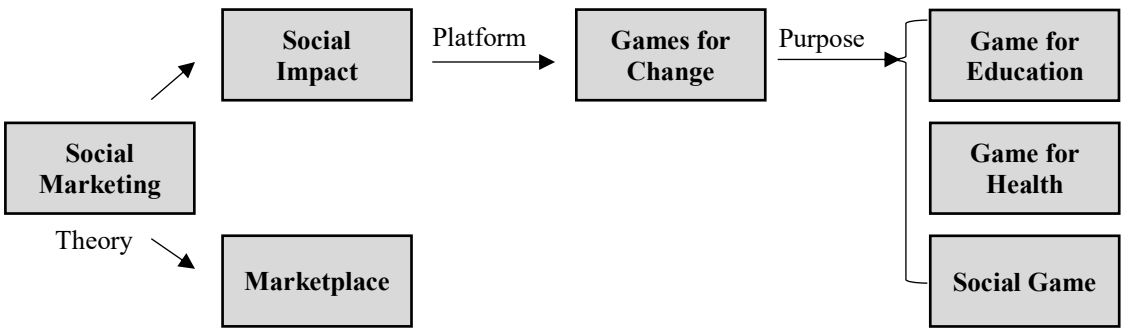

Figure 3.4: Social marketing interaction with games for change.

The conjecture of the research is that social marketing, social community and games as games platforms can be used in order to help the dementia family carers at pre- and early-stages to understand dementia and increase their knowledge of health issues. To approach this goal, social media would be used to deliver messages about social causes to an audience, combined with social media to create an online community; the purpose of this is to use the games platform to interest people, to encourage engrossment in the delivery medium and by so doing allow more knowledge to be absorbed. The following research explores these postulates.

3.1.4 Constructing the Framewrok

The framework elements were constructed based on the literature review in **Chapter 2. Table 3.2** shows the issues that were derived from the framework elements. The elements were split between two areas; Carers' Needs and Games for Change. In this context, social marketing, social media and games are focused on social impact, which involves improving people's engagement in a particular subject. As a result, the key element found to support dementia family carers was engagement. A conceptual framework was proposed to support dementia family carers' needs according to three components: Education, Health and Social, as shown in **Figure 3.5.** The application of games for change involved three platforms: Social Marketing, Social Media and Games, as shown in **Figure 3.6**.

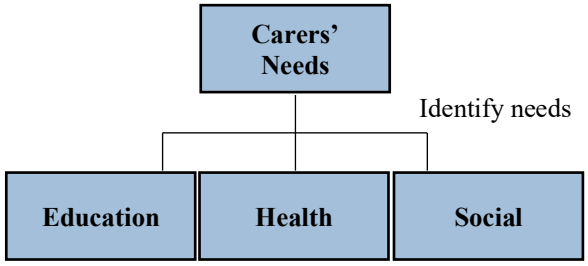

Figure 3.5: The three components of Dementia Carers' Needs

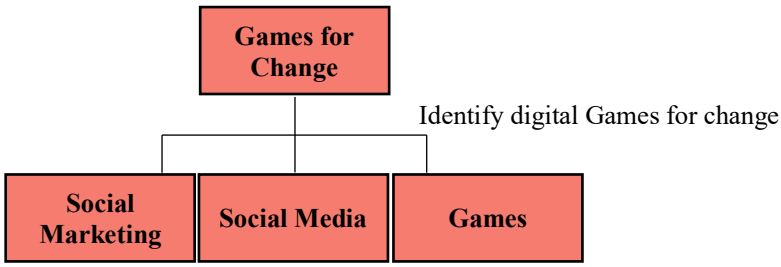

Figure 3.6: The three components of Games for Change

The intention is to use engagement to support carers by producing social change, improving health and providing education, which will increase or create the communities to improve people's health by informing them of the health issues. Games for change, which use social marketing technologies, provide knowledge that supports engagement; social media provides connections to support engagement, and the game provides engaged users to support involvement with the issues. Applying games for change with social marketing knowledge (though social media) can help to achieve social action and use games to interest users involved with different purposes within the social, health and education areas.

The proposed framework in **Figure 3.7**, arrived upon during the development framework stages, was to discuss carers' needs and the use of games for change to support dementia family carers. In the problem domain of dementia carers, games for change services provide social, health and education support for dementia carers by increasing community size and improving their knowledge of health issues.

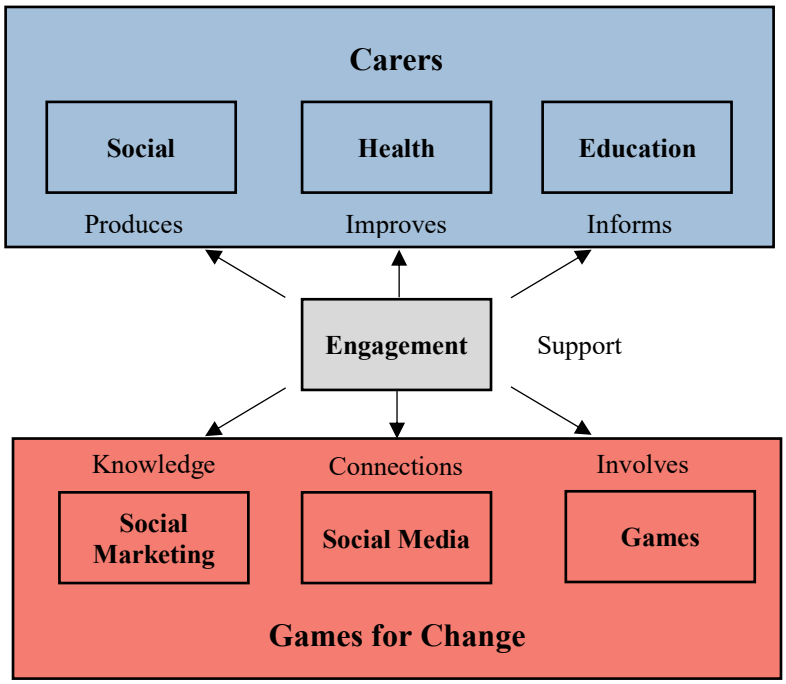

Figure 3.7: Conceptual Framework

3.2 Chapter Summary

This chapter described the framework development process for dementia family carers at pre- and early-stages based on the **Chapter 2** literature review. The framework contained nine elements, including carers' needs, education, health, social, engagement, games for change, social marketing, social media and games. These nine elements were grouped into three components, including Social, Health and Education (representing Carers' Needs) and the three platforms of Social Marketing, Social Media and Games (representing Games for Change). The framework attempts to combine games for change platforms, since each platform serves different purposes, such as creating communities, increasing knowledge of health issues, and improving health action, particularly for dementia family carers. The findings from **Chapter 2** were discussed in terms of the importance of dementia family carers research, especially at pre- and early-stages. There is currently limited existing research and items to support for dementia family carers, which indicates a gap in the research and market. The following chapter discusses the overall research methodology and the design of the conducted research methodology to confirm and refine the dementia family carers' framework.

Chapter 4. Methodology for validation the framework

The preceding chapter presented the process of framework development based on the literature review. This chapter describes the overall research methods, including quantitative, qualitative, mixed methods and triangulation. Additionally, the design of the experiment research mythology to confirm and refine the framework for dementia family carers is defined.

4.1 Overview of research methodology

The research methodology consists of quantitative and qualitative research. Quantitative research is designed to analyse a large amount of data collected from a large number of participants. This type of methodology involves questionnaires, structured interviews, observation and documents for the generation of quantitative data (Morse, 1991). The collection of qualitative data can be useful in helping answer a specific research question (Hove & Anda, 2005). The qualitative research provides open-ended data responses for particular research problems. The advantage of open-ended questions is that they allow respondents to provide more information, while closed-ended questions provide more simplicity. The disadvantage of open-ended questions is that interviewees need to spend more time being interviewed; there is the risk that interviewees might lose their patience, while close-ended questions provide limited answers. Thus, quantitative research is more suitable for research to test the validity of ideas, as it provides closed-ended data (Borg & Gall, 1983). To summarise, quantitative research is suitable for understanding large amounts of data and qualitative methods are suitable for giving detailed information and deeper understanding of the research issue.

4.1.1 Mixed Methods and Triangulation

Mixed methods research involves combining quantitative and qualitative research. There are five types of mixed methods research, described as follows:

1. Triangulation: This method combines the results of two methods to address research problems, such as quantitative and qualitative research (Morse, 1991,

p.120). It can be used to combine recognition data or investigator surveys (Oppermann, 2000, p.143).

2. Complementarity: This uses the results from methods of elaboration, enhancement, illustration, clarification with the results from others. It is used to combine two types of research synthesis, such as narrative reviews and meta-analysis (Ellis, 2015, p.285).
3. Development: This method can aid development design. It is focused on putting theory into practice (Greene, et al., 1989, p.267).
4. Initiation: This combines qualitative and quantitative methods to find the paradoxes and contradictions as an initiation intent (Greene, et al., 1989, p.268).
5. Expansion: A mixed methods approach to expand from an empirical review (Greene, et al., 1989, p.269).

4.1.1.1 Triangulation

Triangulation is based on the triangle analogy. It implies that a single point can be considered from three different and independent sources with quantitative and qualitative methods (Adamson, 2005). In general, the triangulation methodology can combine expert interviews (with qualitative data) and surveys (with qualitative data) to integrate theoretical aspects and practical approaches, as shown in **Figure 4.1.**

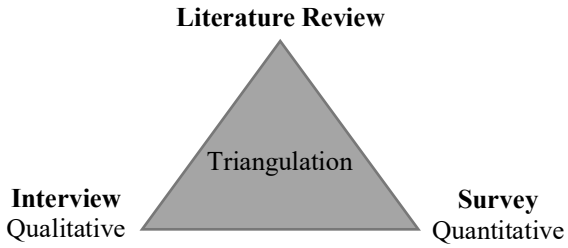

Figure 4.1: Triangulation techniques

Triangulation has four types (Denzin, 1978):

1. Data triangulation: Focus on a variety of data sources.
2. Investigator triangulation: Investigation and analysis processes with several pieces of research.

3. Theory triangulation: Based on a theoretical view; involves multiple perspectives to interpret a single set of data.
4. Methodological triangulation: Involves qualitative and quantitative methods to collect data (e.g. by interviews and surveys).

4.1.1.2 Interviews

Interviews are used to collect qualitative data. There are two general forms of interview (Briller, et al, 2008). The first form, individual interviews, involves one-on-one discussions between the participant and interviewer. In the second, group interviews, the discussion is between participants in a group. Individual and group interviews are suitable methods to gain a deep understanding of an issue (Oishi, 2003). The advantage of the individual interview is being able to provide deep information. On the other hand, group interviews may have a group effect (Kaplowitz & Hoehn, 2001), where the group will follow the leader, or the majority of the group's ideas. The audience chosen can be strategic (i.e. particular experts in particular fields or the target audience or particular age groups), or represent the population as a whole, depending on the research aims. Due to the qualitative methods to collected interview data, between three and five evaluators should be able to uncover substantial usability problems in a system, and most of the potential problems can be identified with ten participants (Rogers, et al., 2011). Semi-structured interviews are used by leading researchers and leading carers in academia and industry (Zimmerman, et al., 2007, p.494).

4.1.1.3 Survey Questionnaires

Questionnaires are a research method used to collect quantitative data from a large number of people. These can be distributed as self-administered questionnaires, which the participants can complete by themselves. It is used to sample a larger representative of the population (Borque & Fielder, 2003). However, it can be unreliable, as different participants may interpret the scales used in the questionnaire in different ways; what one person thinks "Strongly Agree" means may be different to another person.

4.1.1.4 Game analysis

Game analysis is the specialised research methodology used within game user research. It is focused on the interaction between players and games. Nathan Dutton and Mia Consalvo claim that there has not been much research into the methods of analysing games, but it is nevertheless possible to analyse a game by splitting game play into its constituent parts, such as interface design, computer world and character control (Consalvo & Dutton, 2006). The effect of playing games can also be measured through, for example, study of the numerical skills gained by playing a game: "*Playing Linear Number Board Games—But Not Circular Ones—Improves Low-Income Preschoolers' Numerical Understanding*" (Siegler & Ramani, 2009). Demonstrated an experiment to prove young people's numerical skills were improved. The purpose of game user research in academia is to understand motivations and explain/predict the player's actions, in order to help game design and development. Game user research relates to various areas, such as psychology (including human factors and ergonomics for the technologies involved), the experience design, interaction design and computer science[12].

4.2 Research Methodology Design

In accordance with overview of research methodology, the triangulation methodology was selected to confirm and refine framework for dementia family carers because multiple perspectives were needed to confirm the findings of the literature review, and how they were interpreted in the framework (Oishi, 2003) (Siegler & Ramani, 2009), which also discussed the overview of the research methodology, outlined in **Chapter 4.1**.

The research methodology to gather the qualitative data for this study comprised of three parts: the literature review, expert interviews and game analysis. The literature review contained quantitative data as well as qualitative data. The findings of the

[12] http://gamesuserresearchsig.org/what-ias-gur/,2016. *IGDA GAMES USER RESEARCH*., SIG.

literature review discussed the challenges of dementia carers and their needs, uncovering the limited existence of research for dementia carers. Thus, there is a niche to use games for change (including the social marketing, social media and games platforms) to support dementia family carers. The framework proposed reframes the issues from the literature review accordingly.

Expert interviews and game analysis were used to confirm the framework of dementia carers' needs and applications of platforms for dementia family carers. In addition, game analysis was used to review existing games with social, health and education purposes, in order to design valuable games for dementia family carers, especially at pre- and early-stages in **Figure 4.2.**

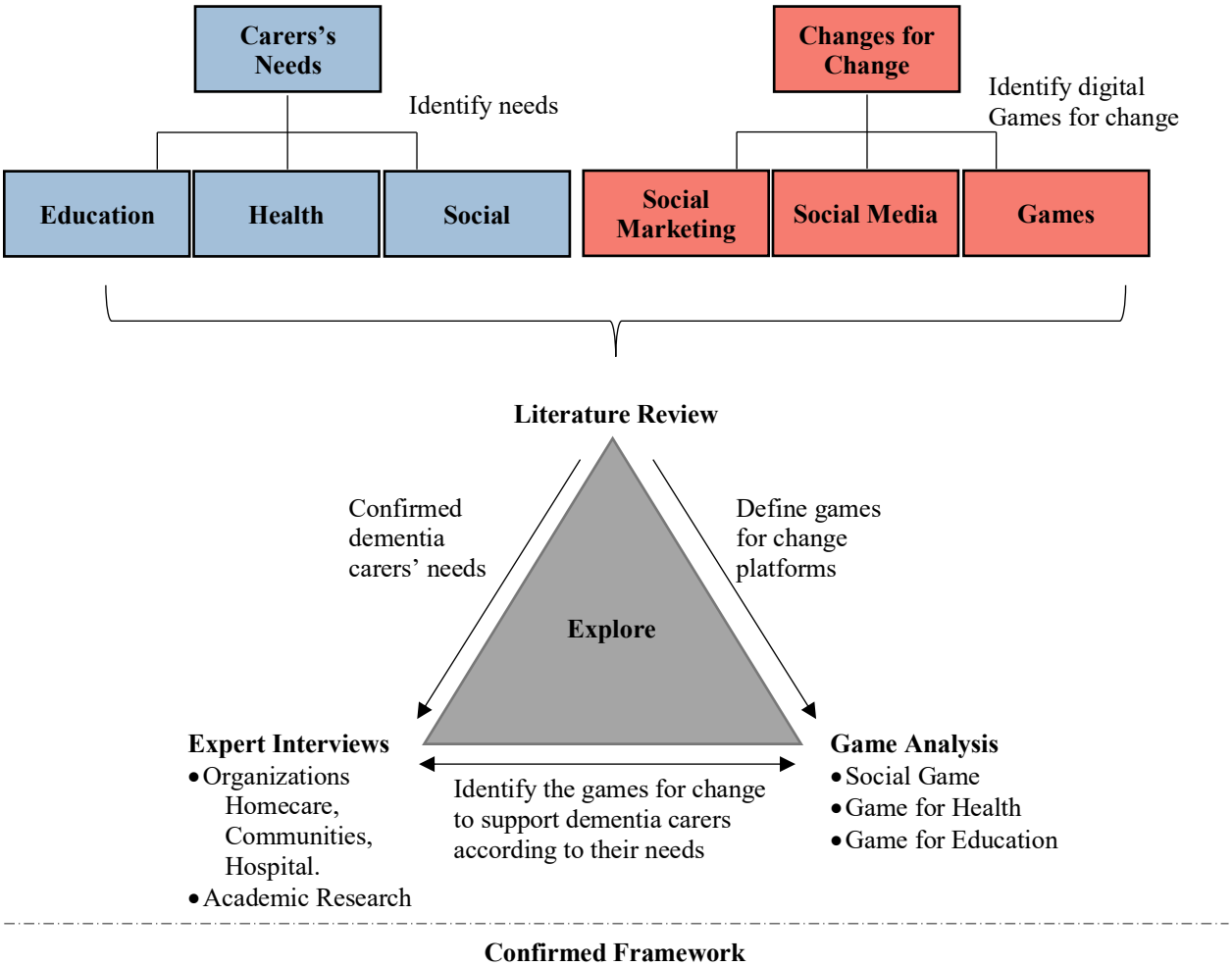

Figure 4.2: Triangulation methodology to confirm the framework

4.2.1 Interviews with Experts

In order to gather requirements for the proposed solution, expert interviews were carried out to gather qualitative data. Ethical approval for the interviews was granted by the University of Southampton's ERGO committee (Reference number ERGO/24047).

4.2.1.1 Interview type

Interviews with experts were used to confirm and refine the framework that had been proposed; organisations for dementia carers, homecare, hospitals, communities and the NHS were considered for the expert interviews for the purpose of designing games for dementia family carers. The experts were required to have up to three years' experience, and knowledge of the needs of family carers, which the platform is trying to address. The interview questions were devised to ascertain the importance of the issues in the framework, such as carers' needs, platforms and engagement. The literature review helped inform the interview questions, including open-ended and multiple-choice answers in **Chapter 4.1** and **Chapter 4.2**. From the data collected, it would be ascertained if the focus of the framework is correct, and provide indicators of the proposed solutions and feedback from the experts (Rogers, et al., 2011).

The expert interviews were planned to identify the needs of carers; Dementia family carers or game experts are not appropriate for the expert interview, as they may have limited knowledge of dementia patients' and carers' needs and of what are suitable technologies for dementia family carers. Experts understand both dementia patients and their families, and also the exciting items that can support dementia patients and dementia carers. Additionally, they can provide suggestions for the development of suitable technologies. For participants' backgrounds refer to **Chapter 5.1, Table 5.1** and **Table 5.2**. To this end, eleven experts were intervened across university researchers and organizations for homecare, communities and other sectors, as shown in **Table 4.1.** Based on the interview methodology review in **Chapter 4.2.1**, the potential problems could be identified with 10 participants (Rogers, et al., 2011).

Table 4.1: Summary of expect of expert interviews

Expert Interviews	Number of Participants
University Researchers	4
Organizations	7
Total	**11**

4.2.1.2 Interview process

For the interviews, permission was sought from a third party to target organizations' staff in the main. The employers contacted included academic researchers, local care homes, organisations, and charities. The interview process consisted of three stages:

- **First stage:** The employer was asked to send an email to their staff, asking for volunteers for the study. An email was then supplied by the researcher to get the responses.
- **Second stage:** If any participants consented to take part in the study, they were given the participant information and a consent form. They were asked to sign the form if they were interested in participating in this research.
- **Third stage:** A convenient time was arranged to meet each participant and conduct the interview. The interview completed the participant information and consent form. Each of the participants were interviewed for 20 to 30 minutes. During the interview, the interviewer gave the interviewee the question sheet in **Appendix A**. The interview was recorded.

4.2.1.3 Interview question design

The interview questions were created with open-ended and multiple-choice questions. The open-ended questions comprised of general questions about the framework, allowing the interviewee to answer extensively. The multiple-choice questions were focused on the three areas of the framework: the carers' needs, games for change platforms and engagement. The questions asked their agreement with a 4-point Likert scale, including *Strongly Agree*, *Agree*, *Disagree* and *Strongly Disagree* (Fink, 2003), and then asked open questions about their opinions of the framework. By combining the results of the open questions and multiple-choice questions, it was hoped to get deep and clear results. The 4-point Likert scale questions were chosen without the neutral

option, as a "forced choice" scale. It was deemed appropriate to use as the 4-point Likert scales were not part of the analysis, but a means of directing the interview questions (Allen & Seaman, 2007).

4.2.1.4 Interview Analysis

The interviews were thematically analysed based on the collected data during the interviews process. Thematic analysis involves identifying, analysing and reporting data based on the "themes" (Silver & Lewins, 2010). The advantage of thematic analysis is flexibility (Braun & Clarke, 2006), where the questions can be adjusted according to each interviewee's specialty. The software NVivo 11 for Mac was used to assist this analysis. The expert interviews were designed to gain deeper ideas of the problems and needs of the carers, while also giving wider feedback for the framework. The multiple-choice questions were used to summarize the experts' feedback. The purpose of the study was to confirm and improve the framework. The themes were therefore based on the 3 areas from the framework; Carers' Needs, Platforms to Support Carers and Engagement.

4.2.2 Game Analysis

There are various of methods with game analysis to categorise games, as shown in **Figure 4.3:** by genre **(Table 4.2),** by platform **(Table 4.3)**, by purpose **(Table 4.4)**, and by content **(Table 4.5).**

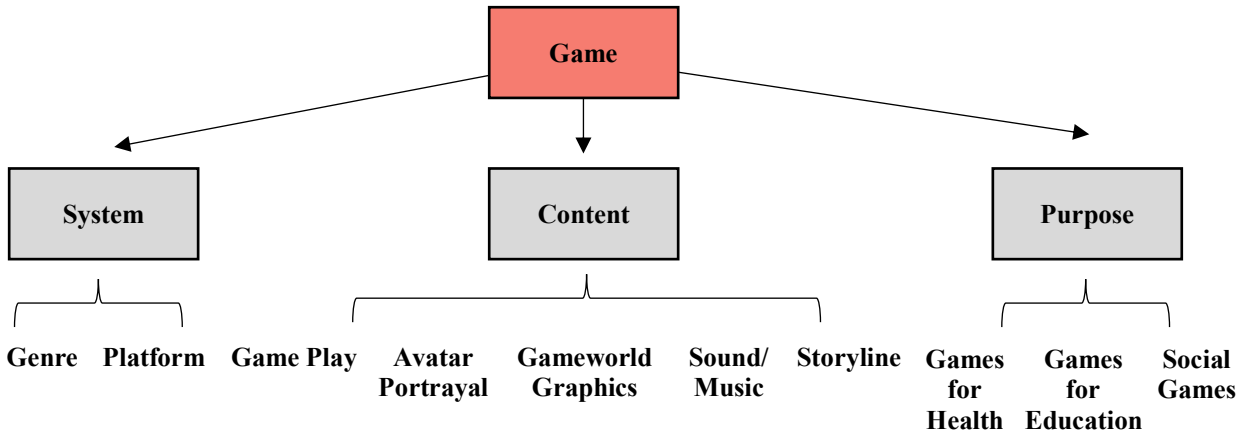

Figure 4.3: Summary of game analysis

The analysis of games by genre and platform was to help understand the different types of games in the industry. Analysing games by genre was done to understand how games apply their various playing methods, including the goal of the game and the methods of interaction (Maksim, 2018), in **Table 4.2**. In the academic research method by genre, the different ability requirement placed on the genres was discovered. Many game genres share the basic game mechanics to an extent; however, user experience is not uniform (Dobrowolski, 2015). Game platform analysis for game developers in considering the current platforms for a different type of purpose and user users can be found in **Table 4.3** (Felix, 2019). The games platform's strengths and weaknesses depend on the different tastes of players. There are games are developed for the health and education sectors, as well as social games relating to the user's community in **Table 4.4 (**Karimi, 2018). The content of the game was analysed with five components describing different game elements, including: Game play, Avatar portrayal, Game world graphics, Sound/Music and Storyline in **Table 4.5**. In the research method and analysis, the game content in each game is reflected on, considering the player's experience in the game environment and game play including the game support, message and collaboration (Dillman, 2018). These elements were developed as the best way to structure the games based on recurring issues in the literature review.

The content analysis components were used to analyse twenty games across each component of the framework: Health, Education and Social. The games were analysed by their popularity, success and features with the purposes of the games, in order to find out the most suitable type of game to use for this research. The games were chosen as digital games for social change, serious games for educational purposes and games for health issues in order to identify how to development suitable games for dementia carers.

Table 4.2: Games analysis by system - Genre

Genre	Characteristics	Example	Reference
Board	Board games are games played on a table. The majority of board games involve at least two players. There are various rules of board games, including teamwork or	Monopoly, Pandemic, Mysterium.	Ladur, et al., 2018 Barbara, 2017

	individual strategy to compete with other players.		
Action	Action games are based on physical challenges. Hand-eye co-ordination and good reactions are needed.	Watch Dogs, Star Wars, Hungry Shark World	Kühn, et al., 2018 Li, et al., 2018
Adventure	These types of games involve exploration of the game's world, and the gameplay involves solving problems.	Monkey Island, Lego Island	Dillman, et al., 2018 Kolar & Čater, 2018
Puzzle/Quiz	The games of puzzle and quiz are grouped as problem-solving games.	MahJong, Bubble Shooter, TenTrix	Barbara, 2017 Wols, et al., 2018
Role Playing Game (RPG)	Players are able to control characters in a larger story.	Diablo	
Simulation	The player interacts with a model of the actual world, such as building a house, bank or public transport of an airplane, train or bus. The situation is designed to be like real life.	Euro Truck Simulator, American Truck	Imlig-Iten & Petko, 2018 Li, et al, 2018 Buil, et al, 2018
Sport	Physical or tactical games. The challenge of sport games includes different athletic models.	FIFA, Mario Golf, Mario Tennis. Olympic Games	Drew, et al., 2018
Strategy	Players take a third-person view with an ongoing storyline and combat development.	Kingdom Rush, Castaway	Shipherd & Burt, 2018, Gorbanev, et al., 2018
Racing	Competitive games based on beating other players across a course.	Mario Kart 8, Gran Turismo	Smith, et al., 2018
Shooting	These games involve trying to shoot other players/ characters. Normally, the aim is to try to survive until the end of game.	Tank! Tank! Tank!, Crysis 3	Dillman, et al., 2018 Mustin, et al., 2018
Platform	These games involve jumping or flying between platforms or obstacles.	Super Mario Bros. U, Sonic Rush	Klaassen, et al., 2018

Table 4.3: Games analysis by system – Platform

Platform	Characteristics	Reference
Xbox	XBOX game titles are normally from the shooting, action or sport genres. It is smaller than the PlayStation, but the XBOX has more choice of titles.	Dillman, et al., 2018 Felix Richter, 2019
PlayStation	The platform of PlayStation games are of a higher quality than the equivalent XBOX and PC games.	Dillman, 2018
Nintendo	The games played on Nintendo systems are more for families or communities to share their time with. The Wii U includes small games to play with groups. The Nintendo 3DS is a small platform - easy to take anywhere.	Felix Richter, 2019
PC	PCs are used to play many different types of games, but their quality might not be as good as XBOX or PlayStation versions.	James, 2017 Felix Richter, 2019
Mobile/Tablet	The games played with mobile or tablet platforms are suitable to play for short periods; users can play while waiting for a short time or during a break. They can also link with social media.	Coutrot, et al., 2019 Stoyanov, 2018

Table 4.4: Games analysis by system - Purpose

Type of game	Characteristics	Example	Reference
Games for Health	These are focused on physiology or psychology approaches. Examples of physiological initiatives include brain training, or linking with outdoor activities. Psychology is linked with education; when users understand their situation, they will change their behaviour.	Skip a Beat Heart Rate, Gululu Interactive Water Bottle, Fiete Choice	Kühn, et al., 2018 Coutrot, et al., 2019
Games for Education	These games are developed as platforms for education, such as to increase player knowledge.	In between, Refugee Mario	Wols, et al., 2018 Kühn, et al., 2018 Shipherd & Burt, 2018
Social Game	The aim of social games is to encourage	Habbo, Happy Farm	Canossa, et al., 2019

	interaction between players, including online and offline play, involving multiple players.		

Table 4.5: Games analysis by system - Content

Content	Component describes	Reference
Game Play	Game play is about relevance to knowledge and skill transfer, as well as how to engage, immerse and motivate throughout the game.	Charles, et al., 2005 Lindley & Sennersten, 2008
Avatar portrayal	Avatar representation is about the personalisation, appearance and behaviour of the character. The player may be able to modify their avatar by gender selection and features. Characters/avatars are selected by character gender, such as asexual, androgynous, multi species, etc. The portrayal/avatar are customised by allowing the user to choose their clothing and physical appearance, such as formal, traditional, culture, western, eastern, etc. The behaviour of the avatar is usually determined by the avatar's role and personality traits. For example, male characters could be strange and female characters could be spies, etc.	Jansz & Martis, 2007 Burgess, et al., 2007 Consalvo & Dutton, 2006
Gameworld graphics	The graphics in a game, including the colours, shapes, etc. Different colours and shapes can show different emotions (i.e. happy colours or sad faces can be depicted). The Gameworld is about the scenes or realistic graphics (such as the showing of shadows or realistic characters).	Klastrup, 2006 Squire, 2006
Sound/Music	The game's background music and sounds. Normally within a game, a user can choose different sound effects or music. For example, players can choose their background music, such as classical, jazzy, pop, etc.	Collins, 2008 Hébert, et al., 2005
Storyline	The storyline which gives the game its meaning. It gives the game a purpose and helps in the development of the game. For example, if the aim is to have a successful farm, the players will need to learn how to grow different types of vegetables or flowers and how to deal with the market's needs.	Eladhari & Lindley, 2004 Crawford, 2003

4.3 Chapter Summary

There are various types of research methodology employed to gain different types of data. Triangulation can be used to combine the qualitative findings from field experts and the quantitative findings from surveying a group of general experts. In this study, expert interviews were used to find the basic ideas of dementia carers' needs and how best to design online platforms within education, health and social contexts. Game analysis was used to provide the advantages and disadvantages of the different types of games according to the health, education and social components, in order to lead to designing valuable games to support for dementia family carers at pre- or early-stages, as well as to improve their knowledge of health issues and engagement in social communities.

Chapter 5. Framework Confirmation - Interview Analysis

Following the previous chapter, the interviews analysis discussed in this chapter in accordance with framework confirmation methodology. Interview Expert method are discussed in the previous chapter in **Chapter 4.2.1**.

5.1 Interview Analysis

The aim of this study is to assert that the games for change platform can be used to raise awareness of dementia and improve dementia carers' knowledge of health issues, such as understanding dementia and information about being a carer. These interviews were about understanding the problems dementia carers face, and identifying what their needs are. The interviews address the three areas of carers, games for change and engagement.

The interview analysis includes four sections:

1. Dementia carers' needs, including challenges for dementia carers and support for dementia carers.
2. Games for change to support carers within technologies for elder adult and purpose of online platforms and designing the game for change.
3. Engagement to support carers.
4. Multiple choice questions analysis.

There were two types of participants, as listed below:

1. Organizations (O): The event organizers in local organizations and communities (Alzheimer's Society, Dementia Friends etc.), general managers in local care homes, commissioners in NHS Southampton and physical therapists in hospitals. These participants were based in Hampshire (**Table 5.1**).
2. Academic (A): Researchers and staff in universities in the UK (**Table 5.2**).

In this study, 11 participants were interviewed in total; 7 participants were from organizations and 4 participants were from universities. (Refer to **Appendix A** to see the sample of questions).

Table 5.1: Respondent's Background: Category 1- Organizations

ID	Status	Area
O1	Organization	Dementia Society - Group Coordinator
O2	Hospital	Physical Therapist
O3	Care home	General Manager
O4	NHS	Commissioner
O5	Organization	Dementia Society - Staff
O6	Care home	Manager
O7	Care home	Staff

Table 5.2: Respondent's Background: Category 2 - Academic

ID	Status	Area
A1	Academician & Researcher	Health Psychology - Serious games / Aging for community.
A2	Academician & Researcher	Health Sciences & Social Network - Health and Social care environments.
A3	Academician & Researcher	Social Sciences - Mental Health and Aging, Dementia
A4	Academician & Researcher	Health Sciences - Older People's Care / Ageing and Dementia research

5.1.1 Carers needs

The basis of the interviews was to discuss dementia carers' needs, grouped into two parts; dementia carers' challenges and supporting dementia carers.

5.1.1.1 Challenges for dementia carers

Being diagnosed with dementia brings huge challenges for the whole family. On the basis of the expert interviews, the biggest challenges that dementia carers face include time, finance, emotion, isolation, and being unable to find the right information at the right time.

A large number of dementia carers do not get enough information. Expert **A2,** for example, thinks carers didn't get information at the right time, and sometimes carers get too much information.

A2: *They get either too much information at the wrong time or they don't get enough at the right time. So it is about trying to judge how much information someone wants in certain point in their journey being a carer and then how to access support.*

For family carers, Expert **O4** has a similar view with Experts **A2** and **O3**, as they think carers cannot find the available information. In this case, carer might not know what resources are available, because they might be unstructured, or there are limited resources in the community.

O4: *From my perspective, I think probably the biggest challenge for carers is around accessing the information. We do have quite a lot of services in the city for people with dementia for their carers but I kind get feedback actually some of the literature on the internet was out of date.*

A2: *A lot of carers said what they don't know what the recourse is around there for them or just support their own role as carers.*

O3: *There is no support structure there. Who is there to go to? Have they had the right information? Which number should they contact? Who is the contact?*

Expert **A3** thinks that, in the pre- or early-stages, family carers might not have enough information about dementia, which would make it difficult to understand and take care of family members with dementia.

A3: *Firstly, they might not even understand what dementia is. So they would struggle to deal with the person with dementia.*

One of the biggest challenges for dementia family carers was pointed out by Experts **A1**, **A3** and **O6**; being a carer comes with great pressure, especially for the main family carer. It might be a long term 24-hour job and have an effect on a caregiver's health.

A1: *I think people find it difficult because it is a 24 hours' job. Carers need to give them a lot of time, their free times, divided to the person who they try to support, obviously they are not, so it is very difficult for them to have their own kind of likes outside of that, and a way to leave at their stress from their feelings. They get stressed because they're working [all the] time and they have to get proper recourse, avenues or places to reduce their stress.*

A3: *Time, do they have time to actually engage with your game or [are] they so busy to looking after their parents or [are] they so busy with going to work.*

O6: *It is actually caring for a person 24 hours a day that is one of the biggest challenges.*

There are examples from Experts **A1** and **O7** about the relationship between dementia patients and their carers. They suggest that carers try in their daily lives to stay active and healthy. and let dementia patients continue to be who they are.

A1: *They need to not just take over the tasks but actually encourage people with dementia to continue to do the tasks like make bed or help for washing up …*

O7: *The big challenges are to try and still do what they want to do.*

The biggest challenge for dementia family carers is isolation, according to Experts **O1** and **O3**; a carer might put their own needs aside, but they feel an overwhelming sense of isolation.

O1: *The carer, depending on level of communication the person with dementia has, the carer can feel very isolated even knowing they got the person with them.*

O3: *That most definitely is isolation and also support networks. It is getting better but in illness a lot of family carers don't get support as they need. So they struggle on and struggle on and generally the point they get to where are looking for help, they almost burn out because they cannot carry on anymore. For me, it is a massive challenge for them.*

Being a caregiver, especially a family carer, can result in various negative emotions and worries, according to Expert **O1**. They might do not what is next step and what is best option.

O1: *Carer can be very, very low depression, can be depressing and anxiety. A lot of time they feel coming to the group is a social interaction and support for them as well for the person with dementia. Depending on what family they get the psychology support can be a challenge for them. Depending on their supporting network. Helping them to improve network.*

Caregivers are reluctant to express negative emotions, or do not want to burden others with their problems. They might tend to bury negative feeling, or pretend they are not feeling them. However, Expert **A4** felt that caregivers need to be understand that they should take care of themselves.

A4: *I think probably the biggest thing is taking care of themselves.*

The finance issues are a problem for family carers, from Expert **A3**'s point of view. Family carers might affect their daily lives to provide support for their dementia patients, such as resigning from a job, turning to part time job - even moving house nearer the dementia patient or living with them. These can result in finance issues for them.

A3: *The other thing is to think about their patient. If they suddenly stopping work, they're stopping contributing to their employment. They might be causing problems themselves when they retire in the future and they won't have enough money to live on.*

The main problem of dementia family carers is that they do not get enough or suitable support. It might bring negative emotional issues, such as family carers feeling isolated, depressed and stressed, because they do not know what to do, or what is the best option. There are many ways to support dementia family carers. But the main issue to address first is to provide them with the basic information about dementia, how to help those with dementia, and the common issues surrounding it.

5.1.1.2 Support for dementia carers

There are existing items in the UK to support specific carers who look after dementia patients , such as Alzheimer's Society, Carers in Southampton, Age UK, etc.

There are available resources to support dementia carers with various of organizations and societies, according to Experts **A3**, **O4**, **O6** and **O7**.

A3: *Place like Alzheimer's Society is really good. They do provide support for family carers; you can ring them up, you can find information on the website. Alzheimer's Society do a lot and charity, Carers in Southampton, Age UK and so on.*

O4: *Carers in Southampton who provide quite an important role for interns to supporting carers to make sure they're accessing kinds of help and support. Also around carers we had Memory Café, which is focused more on supporting carers and other services providing café is more support around person who living with dementia."*

O6: "*There is, you got respite care available, you got day centre available, you got dementia friendly, day facility.*

O7: *There is a lot there. Television now on the paper but I still think they could be more but I don't know how much more. Most people recognize everything now. Dementia friends.*

There are aids to support dementia which are related to helping carers at the same time, according to Expert **A4**. There are various organisations or events which are mainly for dementia patients. However, carers are allowed to join with dementia patients at some of them, such as Singing for Brain or Dementia Café.
A4: *"I can think the various aids which might support somebody who get dementia their carer might find helpful."*

In the UK, there are dementia friendly cities or towns covering every aspect, according to Expert **O5**.
O5: *There is quite a lot out there. Southampton has become a dementia-friendly city now and Eastleigh is a dementia-friendly town. I would say a lot of experts are covered because it's personal.*

Conversely, Expert **O2** does not think dementia carers are able to get enough support, and also have difficulty in finding resources, which might negatively affect their emotions.
O2: *You cannot get enough support. Sometimes talking to people who have dementia do not, haven't been able to find recourse available, so they might feel quite low, etc.*

Experts **O3** and **O4** agreed that there is a lot available in the market to help dementia carers in their life and work, but more can be done. In addition, Expert **O3** brings up the issue of nurses who do not get enough training.
O3: *They do have support groups now by dementia camping. There is a lot of session on Dementia Friends. So much out there for people said I need to support. Doctors are getting better at diagnosing. All that is much including but I think still have long way to go, definitely.*
O4: *There is a lot but can do more.*
O3: *Also in our training even for nurses. Dementia training is not good as they could be.*

Experts **O1** and **O3** disagreed that every aspect has been covered to support carers. There are a great number of organizations or events to support carers, but it is impossible to cover every aspect; therefore, the first step is to achieve the main issues.

O1: *Regular support Alzheimer's Society is trying to increase. There is specifically for carers such as help for funding. Need more support work and advice to meet their needs.*

O3: *It is getter better, but I think but older generation is not covered well. There are different types of dementia. There are so many aspects. They all get different symptoms and reactions.*

There are support for dementia carers - while it does not cover every aspect, Expert **O7** claims it is still ongoing.

O7: *No, we still learning different things, like what we done here, inside 10 years they'll find out better things to do, so it is ongoing.*

Expert **O5** thinks the main support for dementia carers is about understanding and awareness of dementia, and this would help carers most in their occupation:

O5: *Support, understanding been awareness they can assess. Going to shops that have dementia friendly places so people actually understand and that is to help their situation.*

Moreover, Expert **A1** thinks education for the carers might be helpful to support carers, such as by raising the knowledge of health issues to support dementia carers.

A1: *Having access to more knowledge about the condition. Whether both of medical professional knowledge or health for professionals they can stand what condition might have happened how they can support that also I think having access to knowledge from local communities around their experience support someone with dementia and their experience of using service might be available in communities so people who know when services is running or actives running how they can use this staff how they that kind of support.*

Expert **O2** thinks raising awareness can support carers; specifically, the awareness of dementia issues to support dementia family carers, especially for pre- and early-stages. In order to understand dementia and finding the support.

O2: *I think awareness, the awareness about dementia so they know are they understand a bit so why person would be acting there were. Look around the ways how to help patient or the person with dementia.*

In Expert **O6**'s point of view, communities can help carers in different ways, carers who have the same level or stage of dementia can share their ideas to support each other. The community development is to support various issues for individual problems especially, using local communities to reach a deeper understanding of individual needs.
O6: *With a support group experience in same at same level of dementia as you get different stage of dementia so you would want talk people you got same level of dementia same stage of dementia as you are but also I got experience of carer I could see if someone didn't have experience dementia carers them how to cope, how to deal with situation be education on de-escalation techniques, techniques coming, things like that.*

From the interviews, most of the experts do think there is some support for carers, but it needs to be improved. From this result, there are problems for the carers, as even available items to help dementia carers do not cover every aspect, and the information for available support may not be easy to get.

5.1.2 Games for change to support carers

Games technologies can be used to support dementia family carers, using social media and games to encourage users to change their thoughts or behaviours.

5.1.2.1 Technologies for elder adults

Technologies might be useful to deliver the information. However, older adults might find it hard to use these technologies.

From Expert **A4**'s point of view, older adults are not able to assess these technologies. Similarly, Experts **O4 and O5** think there are older age groups of dementia carers who have limited technological ability, or do not use online technologies:
A4: *.... Actually, the older adult carers wouldn't necessarily have access to, won't use social marketing. Although, [that is] more about being maybe scared of computers.*
O4: *Obviously care of people with dementia are going to be in the older age groups. They asset social marketing, media and types of games probably quite limited so in that expect you need to consider obviously young carers in term of son, daughter etc.*

O5: *Provide social media let is fine to provide a lot of people around it but in the elderly generation they not interface work social media in the phones, apps thing like that. Some are but some obviously aren't.*

Expert **O1** had different thoughts about digital technology, as generation-change people will be more confident about using online technologies. The technologies are increasing in the marketplace; in general, people have a basic of knowledge of the technology.
O1: *As generation change if technology can keep up that will realise a lot of pressure for people as well. Like Facebook twitter.*

The advice from Expert **O6** was that the framework elements needed to have more information, and the unsuccessful items needed to be rethought.
O6: *I think you need to go more detail. Because I think all of these things are probably already there at moment are they in depth enough, probably not. Is community make aware for them, probably not.*

From the experts' point of view of digital technologies, it might be harder for some older carers. However, experts believe technologies might work as generations change. When developing useful digital technologies for dementia carers, their abilities need to be considered. However, it is not impossible; digital technologies just need to be as simple as possible to be accessible.

5.1.2.2 Purpose of digital technologies

Digital technologies can have various purposes within social, education and health contexts. The following discussion is focused on the digital technologies provided for various purposes for dementia family carers.

According to Expert **A1**, digital technologies including online communities and games can help release stress. Additionally, Expert **O5** had similar thoughts regarding games as a platform to reduce carers' stress:
A1: *That might be a valuable thing for carers, as they haven't got anywhere to go to release their stress, they might have just sat at the computer and typed it all out; it's*

quite therapeutic to release that stress, even know it's not useful, but it is useful for the person using it because in that way they can release stress.
O5: *Defiantly reduce stress for both dementia and carers.*

Expert **A2** has an opposing point of view, that dementia family carers might experience negative emotion such as stress, frustrate and worried once they understand the situation. Furthermore, changes in people's thoughts or behaviours are not always positive, which is similar to the idea that engagement is not always positive:
A2: *The actual process to do the game might be in good fun, but at the end of this they're feeling more stress because it actually just makes them more aware what could be happening in their life.*
A2: *I agree, yes, but I also say sometimes the ability of social marketing to change people's behaviour might not always be positive.*

Expert **O6** claims the stereotype of dementia is negative, and people's label of dementia is unsuccessful to support. With this in mind, online technologies may be quicker to deliver information, but need to be careful of words:
O6: *I can say negativity things. If somebody is ready denotes with dementia. They are label quietly is you would just been denotes with dementia if you think all these scary press headline, suffer of dementia is been denotes of dementia it just get bad press about it. All those negativity when someone first denotes be carers as well family will atomicity associate those bad headline.*

Games as an entertainment platform can be used to support a variety of issues. However, Expert **O3** does not think dementia issues can be explored in a fun way as it is a serious subject:
O3: *I don't think dementia subject you could teach fun way because this quite sensitive subject. I struggle of that [game] word as I think it is serious subject.*

Based on the advice from Expert **O5**, games as an entertainment platform can be used for different purposes, such as brain training.
O5: *Some of game we play here in the music kind. It making fun. A lot warm up exercise playing game but I would not say games. Exercise use to simulate of brain part of brain*

is not necessary damage. Quite a lot going on. A lot warm up exercises with body and voice as well.

In the experts' opinion, technologies have various purposes, including raising awareness or increasing the knowledge of health issues for dementia family carers. Nonetheless, not all platforms are suitable for everyone; the wrong one for a particular person would not come out with successful result. In addition, dementia as a sensitive issue, and so care needs to be taken with word choices.

5.1.2.3 Designing the games for change

This subsection discusses the design of games for change for dementia family carers, involving the online communities and games platforms.

For Expert **O1**, online communities are the main platform, but depends on the user's experience. Thus, online platforms should be made as accessible as possible. This will help and be valuable for users, as overly-complex platforms are bring users frustrating.

O1: *Online community is very important. The current generation of carers as we see coming to the groups they still don't used social media such as I think they scared of that. If that can be made as simple as possible for people to understand then is a lot easier.*

O1: *Before have ladies doing research about technologies she would like to try thing our but is too complex will make people afraid and angry stress to understand.*

Expert **O2** suggests games provide meaningful information or message and build up as an entertainment platform to increase the number of players, in turn being useful for the users.

O2: *many people are using game or apps some things like that. And if you make like fun game which also education as well it kind of promote a bit more means more people going to play it, recommended and then you still get message cross about dementia as well I think is important.*

There was a game suggestion made by Expert **O4**, suggesting the platforms to support the relationship between dementia patients and carers will be useful for these technologies.

O4: *It is for patient but it thinks it is kind of developing something with patient will absolutely have Knock the fact for carers as something they can do together and like of share memories.*

The expert interviews suggest that online platforms should be simple to play and easy to understand. In addition, meaningful information and messages about dementia should be provided to maintain the relationship between dementia patients and family carers.

5.1.3 Engagement to support carers

According to the literature review, engagement is the main element to support dementia family carers within online communities and local communities to raising awareness and sharing information.

In Expert **A2**'s opinion, engagement is not always positive because it might bring the negative emotions and engagement within the different engagement levels (referring to Brown and Cairns' three engagement levels in **Chapter 2.2**).

A2: *Engagement reduce stress. How do you know engagement might not increase stress? On the hope I believe you people actually more inform more awardable what is going on more educate either they understand situation so it should reduce stress but it sometimes engagement is services around dementia can actually increase level of stress people in carers because actually later on more expectations and more frustration.*

A2: *Engagement sound like it is positive thing which it should be but you need to thinking about sometimes engagement can be negative thing because it can increase carer stress level because they suddenly aware or they don't understand what they aware they get confuses about what out there.*

A2: *Every one have different level of engagement.*

In Expert **A1**'s experience, local communities to engage people are helpful for dementia patients and carers to receive information.

A1: *My experience to going to café. My project is for old men with dementia but a part of that their carer stay behind and the set in kind of formal club. That is really helpful for one ladies her husband just knows have dementia and is very difficult. Actually when*

she come alone she stay and spoke the other carers in the café she actual pick up a lot of information about the conductional bout what might happened also about please she could go for future support or activates she could attend to help as well.

The ideal of online or local communities, from Expert **O5**'s point of view, is to engage people to share their ideas and support each other. But engaging people and getting them to face their problems is hard work, and dementia and carers need to be understood and get support.

O5: *Other people is support group we also suffering in the same way got other love one their dealing with there is same sort of convaterary."*

O5: *Engaging people actually get people to recognising and face the fact is difficulty. They also to give some of confidence. What they get dementia is not the end of world it can be very sad.*

Being a family carer is challenging work, and can lead to negative emotions, such as loneliness, frustration, depression and so on. Engagement is the main element to support dementia family carers, by increasing the size of communities in order to raise the awareness of health issues and support each other.

5.1.4 Multiple choice questions analysis

The previous interview analyses explored the open-ended questions. This section analyses the multiple-choice questions according to the three framework parts: Carers' Needs, Games for change and Engagement, similarly to the open-ended questions.

The extent of the experts' agreement with each part is illustrated in **Figure 5.1.** The carers' needs are discussed with three areas, including available items for dementia carers, games for change platforms and social communities.

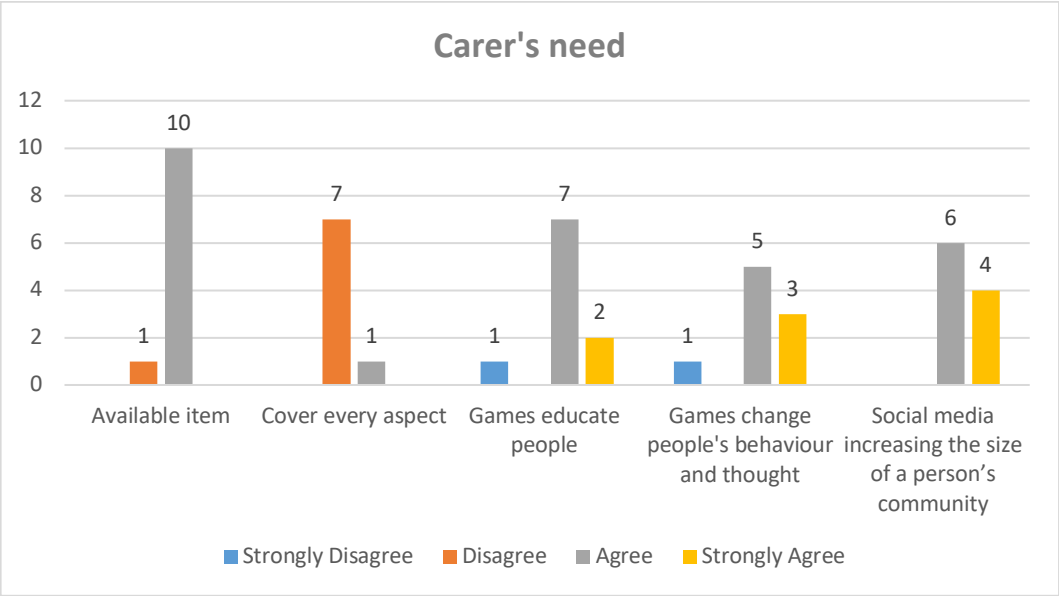

Figure 5.1: Expert interviews about carers' needs

The majority of experts agreed that there are available items to support dementia carers. However, Expert **A1** thinks there is not enough support. Even though the experts agreed there are available recourses for carers, most disagreed the recourses covered every aspect of supporting carers, such as Expert **O6**. Only Expert **O5** agreed that every aspect of dementia carers' needs was covered, and Expert **O4** was unsure about the question. Expert **O7** answered in between disagree and agree, because things change very quickly; in the future things could be different as new discoveries are found.

In terms of games for change with different platforms and purposes to support dementia carers, most of the experts agreed or strongly agreed that games are able to educate people as entertainment platforms, while also being able to increase their knowledge of health issues and improve their health. Expert **O3** felt dementia was a serious issue, and could not be presented in fun ways - also struggling with the word 'game'. Expert **O6** thinks it depends on whether its games are for adults and take into account the life history, likes, dislikes and preferences of the individual. Three experts did not answer the question of whether games for change can be used as a platform to change people's behaviour and thoughts. Expert **A2** was not really sure how the games for change platform would work; Experts **O4** and **O7** meanwhile thought it depends on the users. For example, a scribble map could be used to keep their mind going, but sometimes if

they cannot think of the words, the user might experience negative emotions. Expert **O3** did not really believe that the games for change platform could help carers' health.

The majority of experts agreed or strongly agreed that social media platforms could increase community sizes. However, Expert **O5** was unsure because they were not into social media.

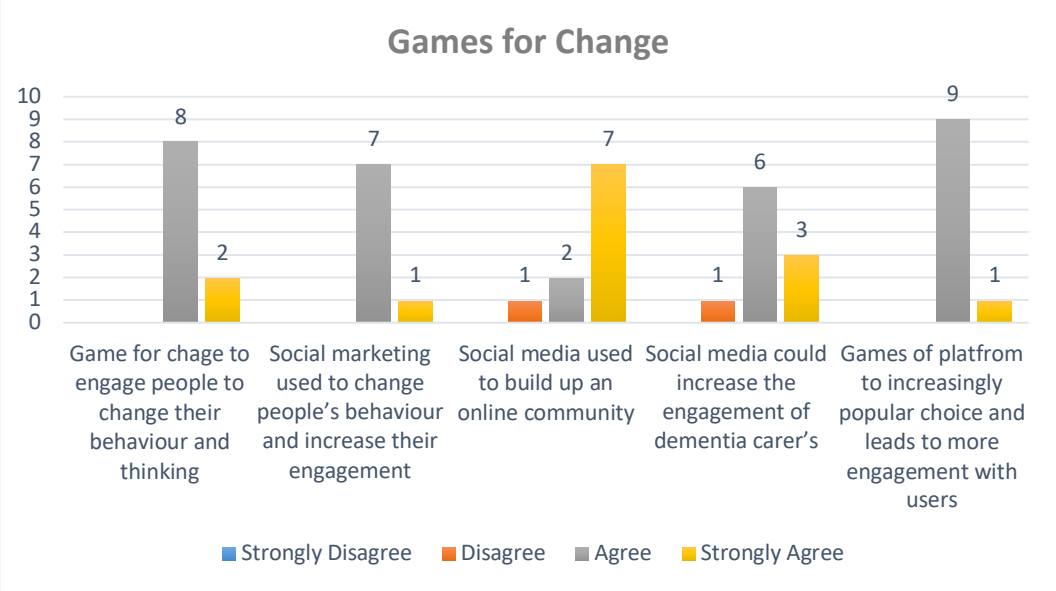

Figure 5.2 Expert interviews about Games for change

The extent of the experts' agreement with each issue of games for change is illustrated in **Figure 5.2**. The overwhelming majority of experts agreed or strongly agreed that a games for change platform could engage people to change their behaviour and thinking; the exception was Expert **O5**, who was unsure about how it would work, but from the previous question agreed that games can reduce stress and teach users. Expert **O5** agreed that social marketing has changed people's behaviour and increased engagement in the past, as did most of the other experts. Expert **A1** strongly agreed that social marketing has been used successfully in the past for different purposes. However, Experts **A3** and **O6** think it depends on how it works, and might not be successful in all cases. In addition, Expert **O7** had a different point of view about social marketing, as it has been used to create negativity about dementia in recently years, such as encouraging negative stereotypes about dementia, which is not helpful or correct information. Form the expert interviews, 7 out of 11 strongly agreed and 2 out of 11 agreed that social

media could help carers as an online community. In accordance with the previous question, Expert **O5** disagreed that online social marketing can build up online communities, as they not in to online technologies; Expert **O2** was also unsure about this issue, as it depends on the person, or how to present the online technologies to the users. The vast majority of experts agreed or strongly agreed that online technologies can engage carers to help broadcast messages on health issues; however, Expert **O5** disagreed, as they did not know how to make it work. Meanwhile, 9 experts out of 11 agree and 1 expert out of 11 strongly agreed that increasing game products is an increasingly popular choice and leads to more engagement with users. However, Expert **A3** was unsure about this, as they mentioned that there are different levels of engagement.

The extent of the experts' agreement with each issue with engagement is illustrated in **Figure 5.3.** Of the experts, 36% strongly agreed and 64% agreed that engagement is the main element to support carers by building up online communities, delivering education and reducing stress.

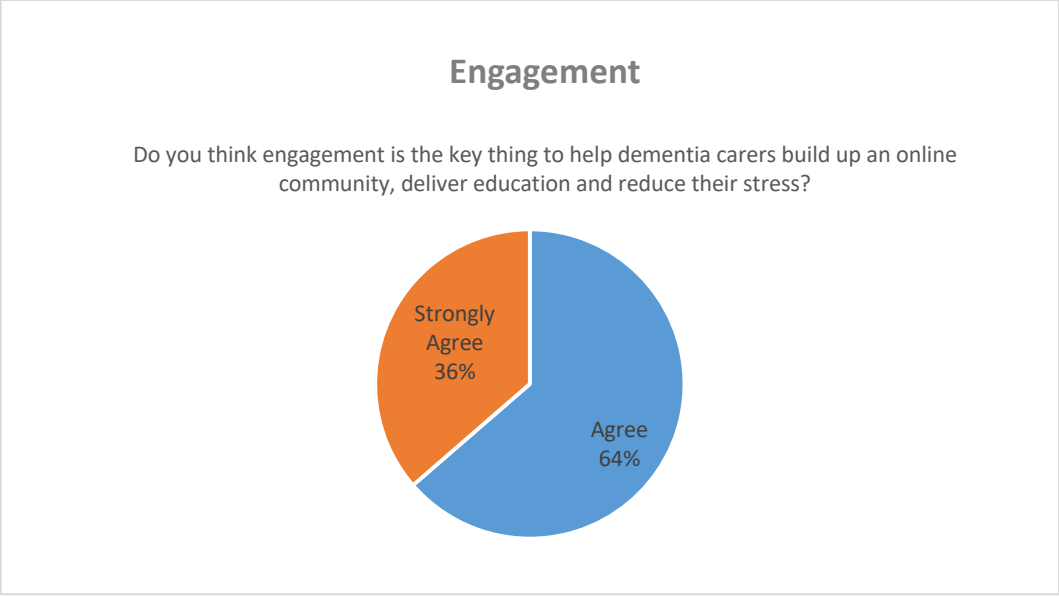

Figure 5.3: Expert interviews about Engagement

5.1.5 Summary of Changes

In the literature review it was demonstrated that engagement is the main element in getting dementia carers involved in order to achieve social community support and to

provide health-related knowledge about dementia and about what it is like to be a carer. In addition, games are an interactive tool providing a virtual experience that assists with an understanding of dementia itself and the needs of dementia patients. The conceptual framework has three important components relating to dementia carers' needs, and the Games for Change platforms provides support for these needs. The framework list is also discussed in **Chapter 3.1.1**, **Table 3.2**.

According to the expert interviews, it was found that there were relevant areas between each of the framework elements which could be closely related; as such, there were suggestions and issues which needed to considered. From the suggestions of the experts, changes were made to the framework, as shown in **Figure 5.4**.

These issues were as follows:
Technologies for elder adults (**Chapter 5.1.2.1**)

- As generation changes occur, there is the possibility of increased uptake for older adults.
- Online technologies should be developed to be user-friendly to encourage general users to use them, especially older adults.
- Online technologies connecting with local communities will be more meaningful.

The aims of the games for change (**Chapter 5.1.2.2**)

- Maintaining the relationship between dementia patients and family carers though online platforms to understand dementia by increasing health knowledge.
- Promoting awareness and understanding of dementia throughout the game. The players can understand the issues of dementia, and also be given advice to support dementia patients, which helped change people's behaviour or thoughts on the issue.
- Engagement with dementia carers (**Chapter 5.1.3**)
- Engagement through social communities is challenging work. It is complicated to work with online platforms and local communities.

On the basis of the feedback from the expert interviews, the following changes were made to the proposed model:

- **The name of *Support* was changed to *Promote*:** Based on engagement being the main element, which is promoted through games for change within various platforms to support dementia family carers.
- **The name of *Involved* was changed to *Interaction*:** Games is an interaction platform to get the player's attention.
- **Links were added to each element related to carers needs:**
  - Social *encourages* Education. For the social communities to receive the information to increase their knowledge.
  - Education strengthens Health. To increase the knowledge of health issues in order to improve their health.
  - Social *supports* Health. From the community support for health issues, both psychological and physiological.
- **Links were added to each element related to games for change:**
  - Social Marketing *integrating* Social Media. Social marketing is a concept integrating with social media to engage users.
  - Game *collaboration* Social media. Games and social media as platforms to engage users. Games deliver the information through collaboration with social media as an online social community platform.
  - Social Marketing *awareness* Game. Application of social marketing theory for raising the awareness to develop a game.

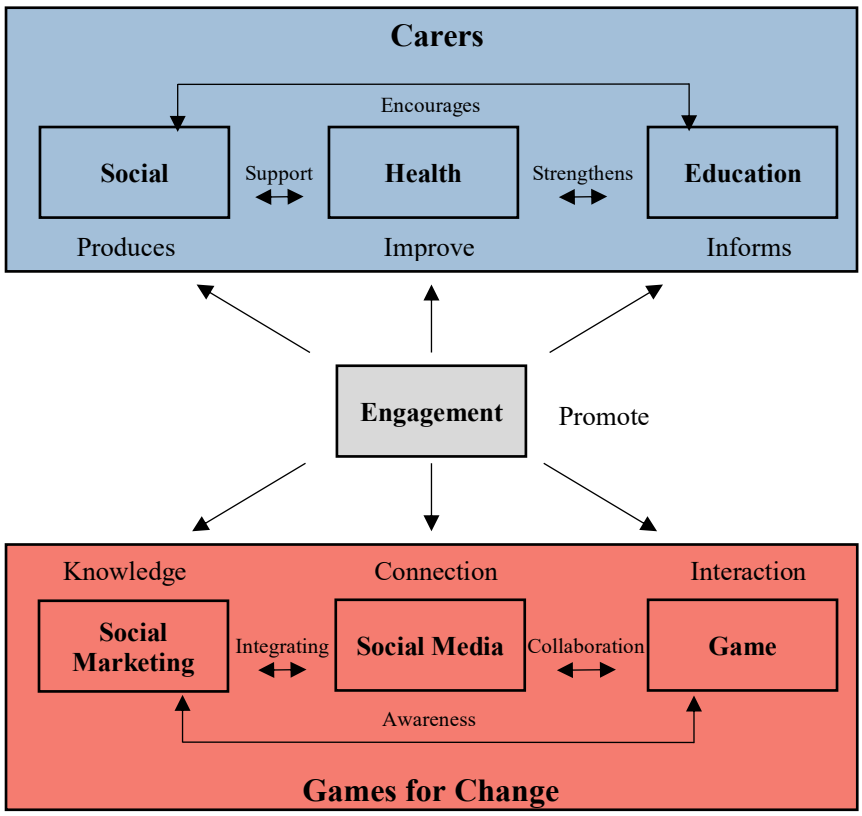

Figure 5.4: Conceptual Framework, following the expert interviews

5.2 Chapter Summary

The purpose of this chapter was to describe how the conceptual framework was confirmed and refined from the expert interviews with eleven participants. From the feedback of the expert interviews, certain linking words were renamed or added in each connection. According to the expert interviews, there are limited items for dementia family carers, especially for their mental health. The way to support dementia family carers is by increasing their knowledge of dementia and provide suggestions for carers. Social support is helpful, but it is complex to involve online platforms and local communities.

Chapter 6. Development of Games for dementia carers

This Chapter divides into three phases, confirming and refining the framework from game analysis; discussion of the methodology for developing an instrument based on the framework; and development of the instrument based on the framework and game content.

The first phase concerns game analysis with twenty games by category and content, and discussion of games for specific issues. The second phase reveals the metric methodology for designing games for dementia carers involving development of metric instrument, piloting and exploratory experiment, design and development of game, and Experiments I and II. For the final phase, the development of the metric instrument within development metric table, and the instrument applied to the game and evaluation of framework element are presented. The game analysis was developed for the metric table in **Chapter 6.3**.

6.1 Framework Confirmation - Game Analysis

The games chosen were digital games for the improvement of social, educational and health aspects, see **Table 6.1**, also discussed in **Chapter 4.2.2**. Most of the games had been reviewed by the Games for Change organisation and had also been reported in various media press. Eight games had been discussed or analysed in the academic research. Game analysis was conducted on twenty games, with the details of each game provided in **Appendix B**.

Table 6.1: Games Chosen - Game Analysis

Name of Game	Description
Aviation Empire	Game is connecting with social media with high number of players.
Backpacker	This game delivers the educational message of traveling. The average rating is 5.629 with 180 players on the BoardGameGeek website.
Cancer Game	This game is reviewed on the Games for Change website which focuses on cancer health.
Cortex Challeng	Based on the brain busting game with various language versions. The average rating is 6.4 with 644 players on the BoardGameGeek website.

Elude	Game reviewed on the Games for Change website which focuses on mental health developed by GAMBIT Singapore-MIT GameLab. This game also been discussed in the conference (Rusch, 2012).
End Game: Eurasia	This is a news game discussing social issues. It is reviewed and analysed in the journal paper (James, 2017).
Fugue	Game delivering an educational message as problem solving.
Homeland Guantanamos	Games reviewed on the Games for Change website, categorised as educational game. Also discussed in the journal paper (Morey, 2011).
Ice Flows	Simple game discussing social impact, reviewed on the Google Play app with 4.5 out of 5 rating, published in various media press notably Wired, SCAR, Science Magazine (Reynolds, 2016).
Inside the Haiti Earthquake	A social impact game reviewed in the award in Games for Change Festival 2011: Transmedia. This game discusses the issues of Haiti.
Let the Cat in	The game with social impact, reviewed in the Steam; mostly positive results with 1.026 reviews.
Pokémon Go	Very popular game also discussed in various journal paper especially in terms of physical activity (Althoff, 2016).
ReachOut Orb	Categorised as education game in the app store. Reviewed and analysed in serious games for health issues (Dekker, et al., 2017).
Re-Mission	Game reported in various media such as Nerdook Productions, Tinime Games, Borne Games, Novaleaf Game Studios. Also used in various research within the game field (Tate, 2009).
Sea Hero Quest	This is a dementia related game reported on by Forbes, The Guardian and the BBC. Awarded 2016 Cannes Lions International Festival of Creativity and 2017 Games for Change Awards. Game also published as paper and reviewed and discussed in various research (Coutrot, 2019).
SideKick Cycle	Game with ratings 4.7 out of 5 in the app store also reviewed by Games for Change. This game had media report in the Mashable, Polygon, The New York Times, and USA Today.
Stressed Eric	The game produced by the BBC, discusses mental health issues.
That Dragon, Cancer	Game with very positive reviews with 902 reviews in the Steam. The story of children with cancer featured in The Guardian and Polygon. Awarded 2016 G4C.
Win the White House	Reviewed on the Games for Change website also in Google play with 5,858 reviews of 4.1 out of 5 ratings. Categorised as an educational game.
Zombie Castaways	The game with 70 million players around the world, with 4.6 ratings. The game, helping zombies become human, is categorised as an educational game.

A subsection of games, which improve a user's health, education or social connections were analysed by their component parts and content in **Appendix E**. They were categorised by genre and platform, and their benefits to the user were described. The content was analysed by game play, avatar portrayal, game world graphics, sound/music and storyline. Some of the games analysed were created by different research groups linked to universities for a wide variety of differing purposes. One such game is "*Re-Mission 2*", which is a research game created by HopeLab and Stanford University giving information about cancer for carers and patients. "*Sea Hero Quest*" a game about dementia is another game developed by a research institution: GLITCHES LTD, a company which has links to the University College London, University of East Anglia and Alzheimer Research.

6.1.1 Game analysis by category

The games chosen were focused on health, education and social interaction and were categorised by genre and platform in **Appendix C**. The game genres and platforms were analysed according to the categories in **Table 4.2** and **Table 4.3**. The game analysis scores correspond to percentages (where 1=100%, 0.5=50%, and 0=0%), according the game analysis methodology in **Chapter 4.1.1.4**. Games for health tend to improve a user's physiological or psychological health. "*Pokémon Go*" concentrates on improving a user's physiological health. "*Sea Hero Quest*", "*Re-Mission*", and "*Win the White House*" train a user's brain or tell a story in order to help users understand how to deal with particular problems. Educational games can tell a story which influences a user's behaviour. A user's thinking can be influenced and knowledge about how to deal with certain problems can be passed on. For example, "*That Dragon, Cancer*" tells a story about how to look after children who have had cancer. "*Aviation Empire*" explains about how to run an airline. The game "*Backpacker*" explores how to tackle the problems faced when a person spends time travelling to different countries. Games can help social communication, and many games that were looked at encourage this behaviour. Board games are normally played with two or more players, which is very social within a small group. Online games spread the interaction with a large number of people; while it is not very easy to achieve, it will only improve as the technology matures.

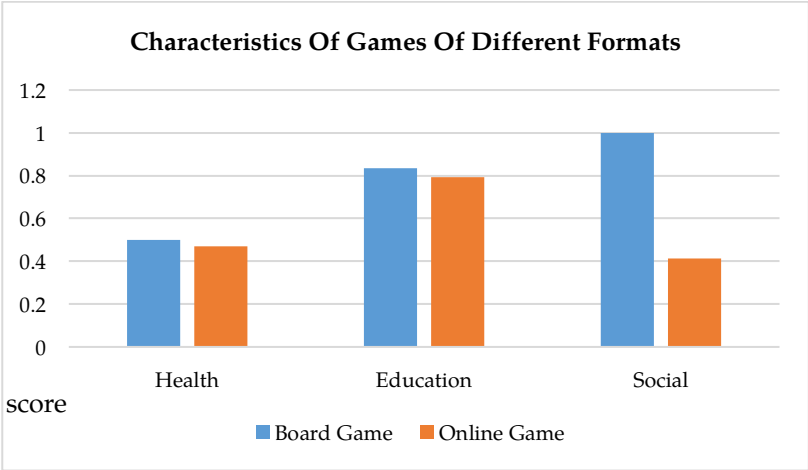

Figure 6.1: Characteristics of games in Board and Online formats

There are many games available which focus on a user's health and education. In addition, games with social aspects allow users to share their gaming experiences with other users, reflected in the Social area of **Figure 6.1**. Of the sample of games chosen, half were aimed at the health market, which fell into three distinct categories: action games, which improve a user's health during game play; brain training games, which help improve a user's cognitive ability in some way; and informative titles which teach users how to prevent and fight certain diseases.

The data suggests that both online and board games can be educational. Table games seem to have a greater social aspect to them, probably partly due to the number of players that play a board game in one place. Most board games are played by two or more players. Online games can be played with huge numbers of people: in a survey of more than 8,800 gamers conducted earlier this year, 72 percent of US respondents said they played games online, up from 67 percent last year (as shown in **Figure 6.2**). However, despite the increase of online games, the board game format seems to encourage social interaction to a greater extent. Some online games are focused on a social aspects, such as "*Happy Farm*"; in this game a player can play anytime with other players and send online gifts to others.

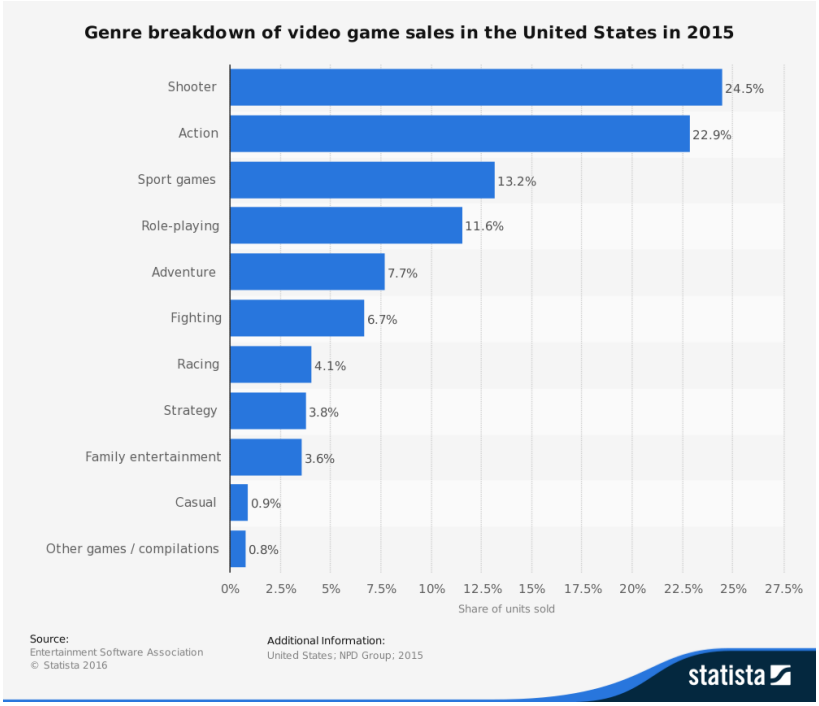

Figure 6.2: Popularity of different formats of games (Statista, 2016)

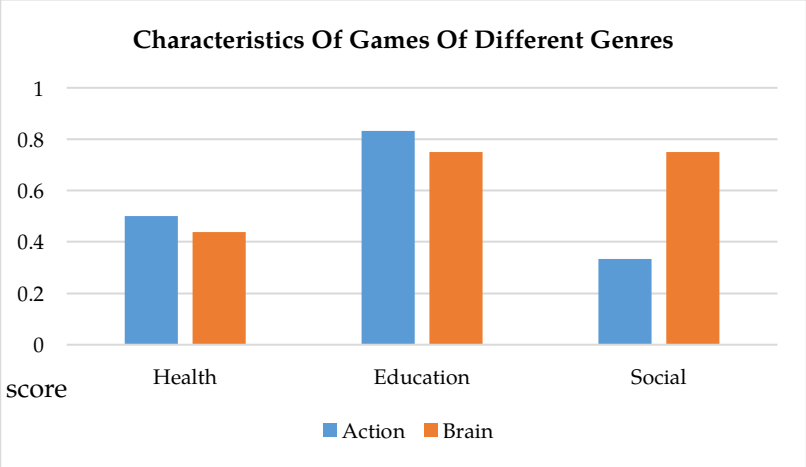

Figure 6.3: Characteristics of Games of different Genres

As **Figure 6.3** shows, both the action and brain genres of games delivered an educational message. This is not really very surprising, as all the games were chosen with an educational slant. The results also show that action games are less social than games which tax the brain. This may be due to the sample chosen, in which most of the action games chosen were online games, or it could be a feature of that type of game.

In fact, most online video games tend to be action games. The majority of online games tend to be less sociable than their board game counterparts, as seen in **Figure 6.4**. The result of board games seems to involve a user's brain to a greater extent, whereas online games seem more likely to be action games, involving quick reaction speeds. Board games tax the user's brain to a greater extent. Strategy and teamwork is often involved in board games in order to win and hamper other players. Some parts of brain games can involve quick reactions too, like *"Cortex Challenge"*. Online games often require more practice to complete; in the game *"Elude"*, a user can start to understand how depressed people feel and practice how to get out of darkness using ice flows to control the snow and attempt to get stars; the user must practice repeating the same quick actions in order to complete the game.

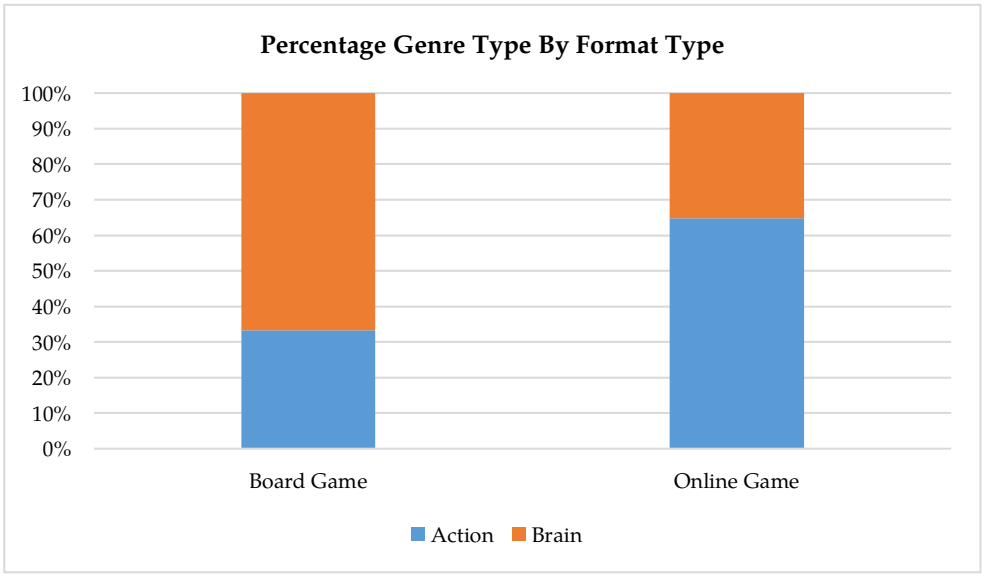

Figure 6.4: Percentage of Genre Type by Format Type

6.1.2 Game analysis by content

Analysing the games by their strength of content in different areas shows how effective each game is. In **Appendix C**, the effectiveness of each game is broken down by the differing content attribute types. The games within the sample were analysed by content in **Appendix D**. The rating scale 1 to 10 is used to rate the games (Chilton, 2014). The detail of criteria is described in **Table 6.2** (Stoyanov, 2015).

Table 6.2: Criteria rating scale

Rating	Criteria
0	The item is non-existent in the game
1	The item shows too little or is non-existent in the game
2	The item shows a little in the game, but with limited related items to support
3	The item shows a little in the game but there are only partly related items to support
4	The item shows a minor portrayal in the game
5	The item shows a moderate portrayal in the game
6	The item shows a moderate portrayal in the game, also with related items to support
7	The item shows a moderate portrayal in the game, also with mostly related items to support
8	The item shows an satisfactory level in the game
9	The item shows an good level in the game
10	The item shows an outstanding level in the game

The content was segmented by game play, avatar portrayal, game world graphics, sound/music and storyline. The games involved different types of elements, thus there were some games with the same score but with different comments. For example, "*Zombie Castaways*" and "*Let the Cat In*" have same score, but have different comments because the focus of each games is different. The story of "*Zombie Castaways*" is to build on an island, and "*Let the Cat In*" shows the problems of stress animals. However, both of the games show a similar level of focus on storytelling, which is why they have a similar score. Game play is a measure of ease of use and a gauge of how interesting the game is to take part in. Some of the video games have different levels, such as "*Sea Hero Quest*", and in some a user is able to choose different mini-games which challenge them further, such as "*Re-Mission*". Avatar portrayal measures the extent a user can choose a different appearance, personality or behaviour of their in-game character. Game world graphics measures the graphics design style; these can include a 3D realistic style, cartoon or simply symbolic design. Sound/Music describes the degree to which music is used to make the game more interesting or encourage the player to become more deeply involved in the game world. The strength of storyline shows to what extent the game's story communicates with the player.

Overall in **Figure 6.5**, most of the design effort seems to be concentrated on visual aspects. Computer-generated images are often combined with real-world images in games, such as in "*Pokémon Go*", "*Inside the Haiti Earthquake*" and "*Homeland Guantanamos*". Perhaps this is because the latter two games are produced for the health and education sector.

Gameplay describes how the games are played, whilst Storytelling is about the underlying meaning of the game. "*Pokémon Go*" scores the highest in Gameplay, because the game combines virtual gameplay with real life activities. "*That Dragon, Cancer*" shows the real-life story of a parent looking after their sickly child, which was deemed a very meaningful storyline.

There are games which tell the story of something real which is happening in the world. "*Inside the Haiti Earthquake"* (earthquake in 2010), "*Homeland Guantanamos*" (the untold story of immigrant detention in the U.S. in 2007) and "*Endgame: Eurasia*" (Syrian war in 2012) are all about real things which have happened in recent years, or are still happening.

Background music and sound effects vary greatly from game to game, and can help involve a player in the game. "*That Dragon, Cancer*" uses real recordings of people who were involved in the game's story. "Inside the Haiti Earthquake" shows how people's voices can create a real environment.

Board games do not provide their own sound effects, but the background sounds depend on how much a user discusses or talks with other players. For example, in "*Stressed Eric*", the players do not need to discuss with each other, but during "*Cortex Challenge*", players need to talk and answer questions to try to win each challenge in the game. The avatar portrayal score depends on how much choice a player has over their own avatar or character.

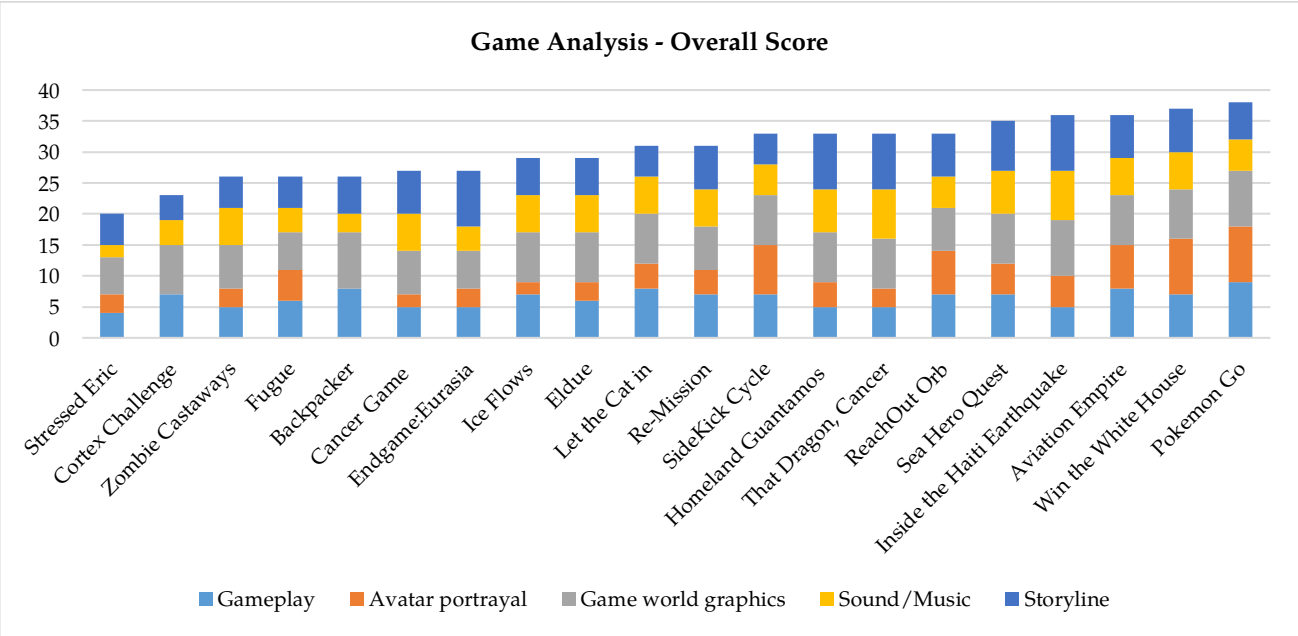

Figure 6.5: Game Content Analysis - Overall Score

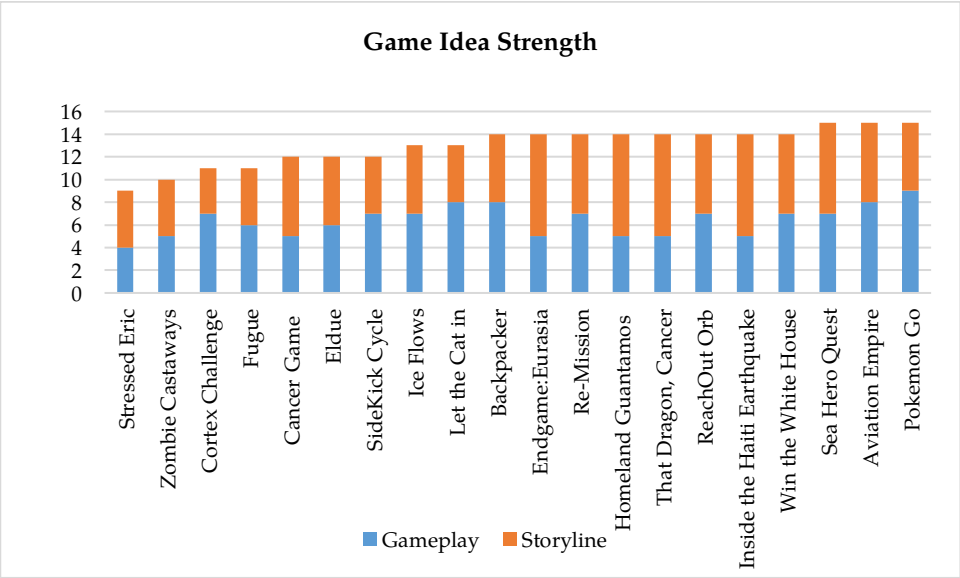

Figure 6.6: Game Idea Strength

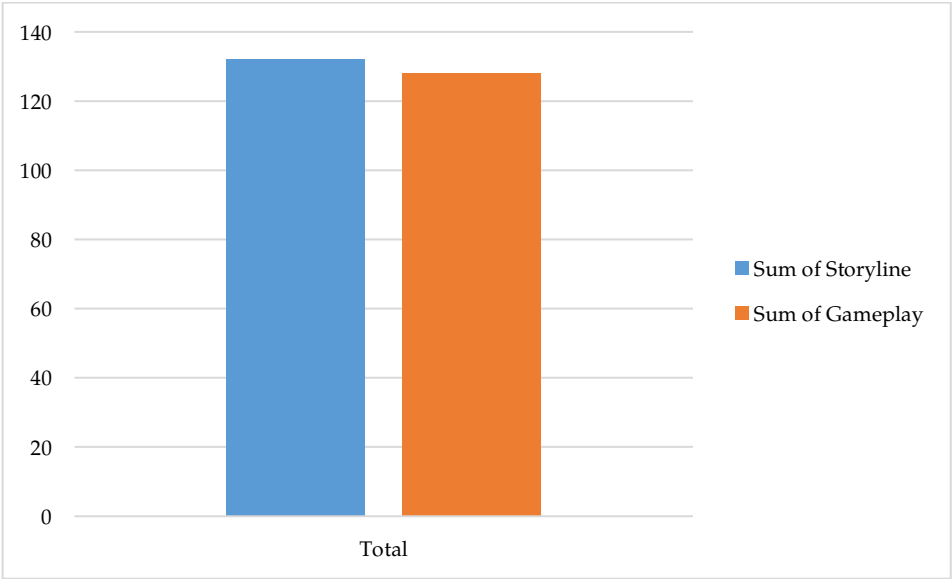

Figure 6.7: Gameplay and Storyline

The importance of a good storyline and good gameplay are seen to be similar in the games chosen, as shown in **Figure 6.6** and **Figure 6.7**. This could be due to the fact that, in the sample, all the games had a purpose and tried to convey a strong message for the player. In the normal game market, popular games might concentrate on being fun to play rather than delivering an important message, as games are a tool of entertainment.

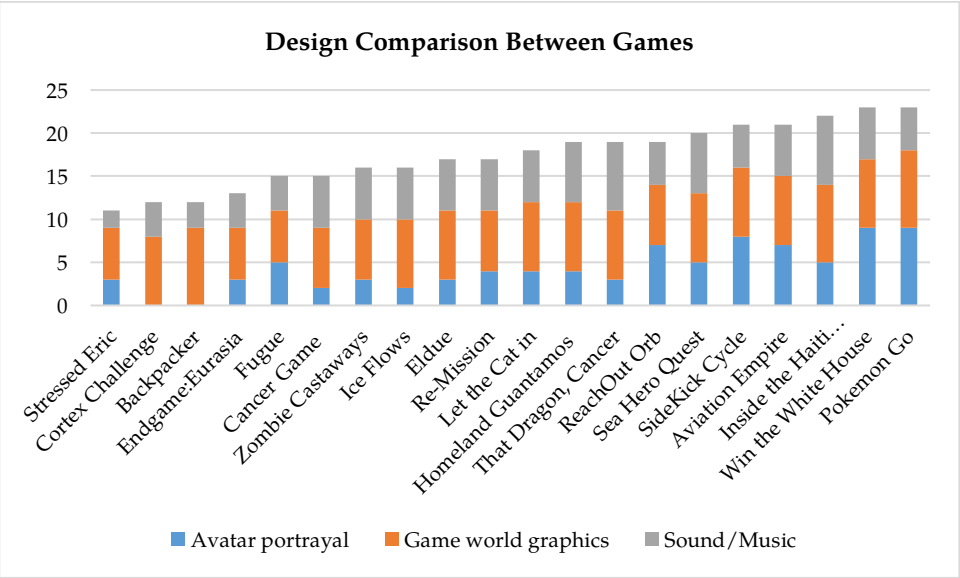

Figure 6.8: Design comparison between the games

From the results, each game does not seem to have the same amount of time or inspiration shown in their design, as seen in **Figure 6.8**. The game concept is main focus for the game purpose. The games graphics design is used to attract people's attention and provide guidelines for the user while they play.

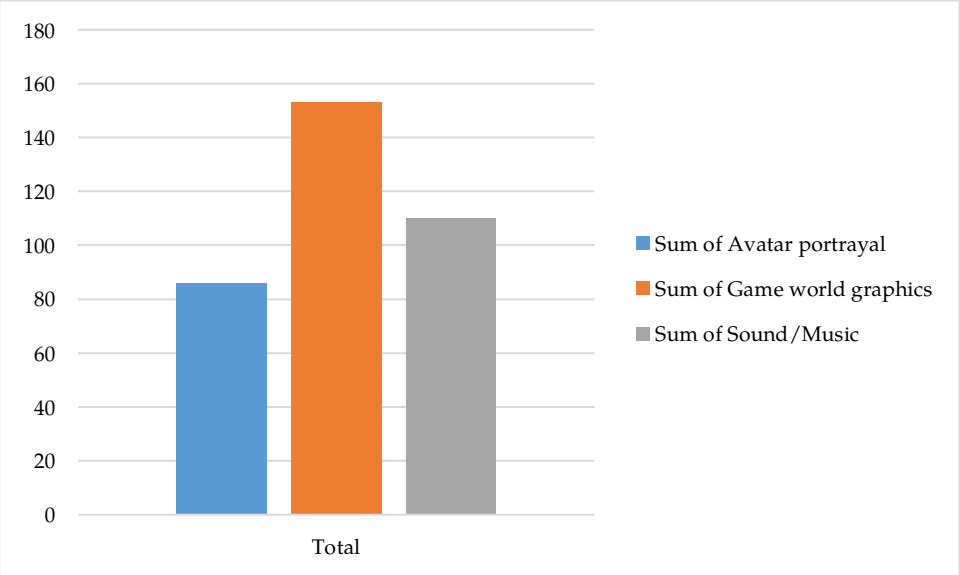

Figure 6.9: Importance of elements in design

In the summary of the games' design rankings, as shown in **Figure 6.9**, graphics seem to be more fully developed than avatars and music. These games were more focused on the visual transmission to the brain, although music elevates the atmosphere in a game for a player.

6.1.3 Games designed for specifically for issues

The majority of games developed to help mental health issues have been developed with the help of doctors; one example is a game created for mental illness called "*The Coping Game*". Mental illness games are developed to help individuals understand themselves, and show them how to make healthy choices. These games can form part of therapy for patients, families and friends to gain understanding about a patient's condition.

The majority of games to aid coping strategies are board games, or card games. There are games to help children understand their emotions and how to face their problems. The games made for the purpose of coping or dealing with stress feature cards without any entertainment value, and are text heavy without good design features, and thus do not capture a person's interest. However, the coping games formats are similar to bingo, and so are easy to create and play.

The purpose of games for social change is to raise public awareness of social issues, such as human rights, climate change and public health. These can be news games or documentary games, and help show information about issues which have actually happened or are currently happening. There have been popular games in recent years focusing on human rights; for example, "*Homeland Guantanamos*" exposes inhumane conditions in the U.S. There are games also highlight the effects of war; for example, "*Endgame: Eurasia*" is about the Syrian war, and "*Syrian Journey*" shows the difficulty in escaping conflicts. Moreover, some games exist for global change; "*Ice Flow*" is a game about ice flows in the Antarctic. Simpler games exist about climate change, such as "*Habitat the Game*", in which users must help keep polar bears alive and healthy. Zombie is a company which creates a huge number of games primarily for fun, while also developing some games with a purpose, such as "*Zombies Run!*", where users must physically run in order to escape zombies. The Singapore-MIT GAMBIT Game Lab

develops games in collaboration with Singapore institutions of higher learning and MIT departments; a research team is used to create games with purposes, such as "*A Closed World*" (describing frustration), and "*Robotany*" (understanding different abilities). Some games are designed for children's educational purposes; one company in the game industry that develops these types of games is called *Wildcard Games*. Examples of these games include "*Arithmanix*" (a game for maths), "*Ah-Harr!*" (a game for strategy and memory) and "*Mapominoes*" (a geography game).

6.1.4 Updated Framework Summary

Games can have different purposes, such as health, education and social. The analysed games each focused on one purpose. However, there are games that involved up to two purposes. The findings, which determine each game's relative merits in education, health and social connections, help to support the health and social impact.

The games could deliver more information to allow carers to face their own lives, and could also improve the relationship between dementia patients and their carers. Games for change could be a platform to educate people, and also could be a type of therapy to release their stress and negative emotions. Games for change might be able to increase the size of a user's community; as a result, the carer will experience less feelings of isolation and become better equipped to face the problems of looking after their family member.

Broke down framework by elements to demonstrate different components and platform, Based on the game analysis as shown in **Figure 6.11**.

- **Framework elements grouping as Carers' Needs components and Games for Change platforms:** Carers' needs were split into three components; social, health and education. Games for change was split into the three platforms of social marketing, social media and game. In addition, engagement was made the main element (shown in **Figure 6.10**).
- **Health was determined as the main component support dementia carers:** The health component was linked with the education and social components.

- **Games were indicated as the main platform in games for change within social marketing awareness games and social media collaboration games:** Based on the game analysis, social media is part of social marketing and social games will link with social media. The games for changes could including social marketing and social media to achieve greater social impact.

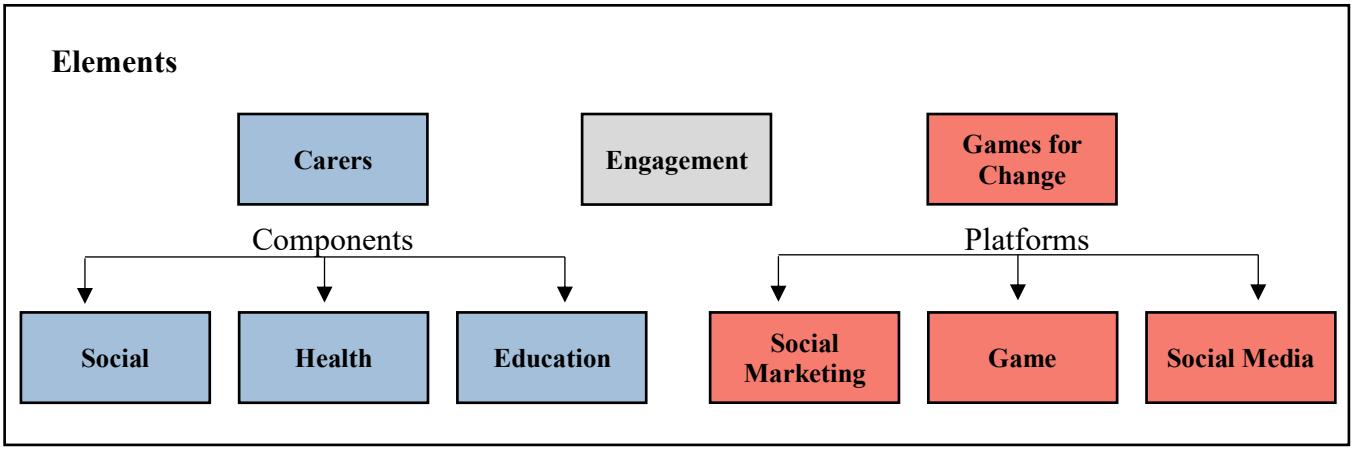

Figure 6.10: The elements of the framework

Based on the game analysis, the framework elements were grouped as components under Carers' Needs and platforms under Games for change **Figure 5.11**. In addition, Health was determined as the main component and Game as the main platform. Games for change incorporate three platforms to fulfil the requirements of the Social, Health, and Education components to support dementia family carers, where the game itself delivers knowledge and suggestions for dementia family carer. As well as being interactive entertainment platforms to engage players, games can help to communicate health issues and improve the relationship between dementia patients and their carers.

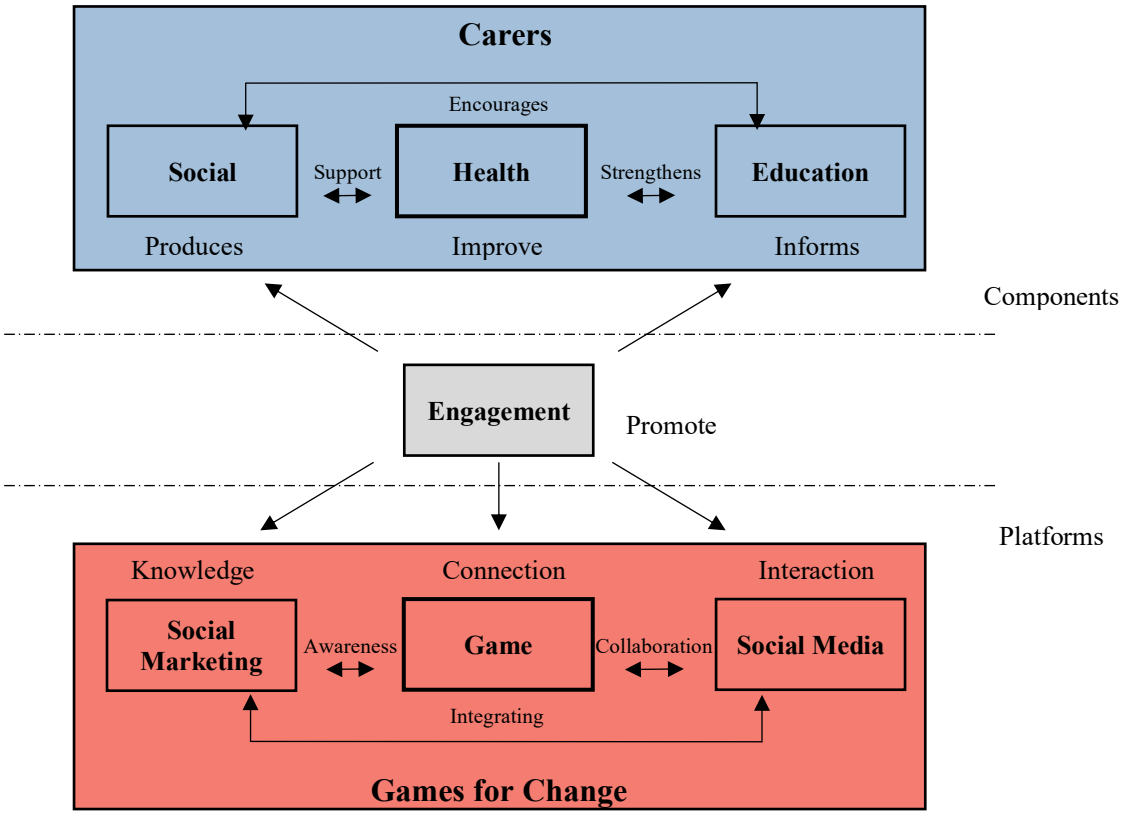

Figure 6.11: Conceptual Framework, following the game analysis

6.2 Metric Methodology for Designing games for dementia carers

After the framework was confirmed by the game analysis and expert interviews, the next step in this project was to answer the following research question:

RQ2: How can the games framework be used to support carers?

This includes the following sub-questions:

Q1: Can games be effective in improving carers' health?

Q2: Can games increase the carer's social community?

Q3: Can games be used to educate carers?

This section is described methodology for developing a measuring instrument based on the framework, piloting the instrument, an exploratory experiment to develop the instrument, and the design and development of a game based on the instrument and an experiment to test its effectiveness. Each experiment is presented by its purpose, method, procedure and method of data collection and analysis. The diagram of experiment progress in **Figure 6.12**.

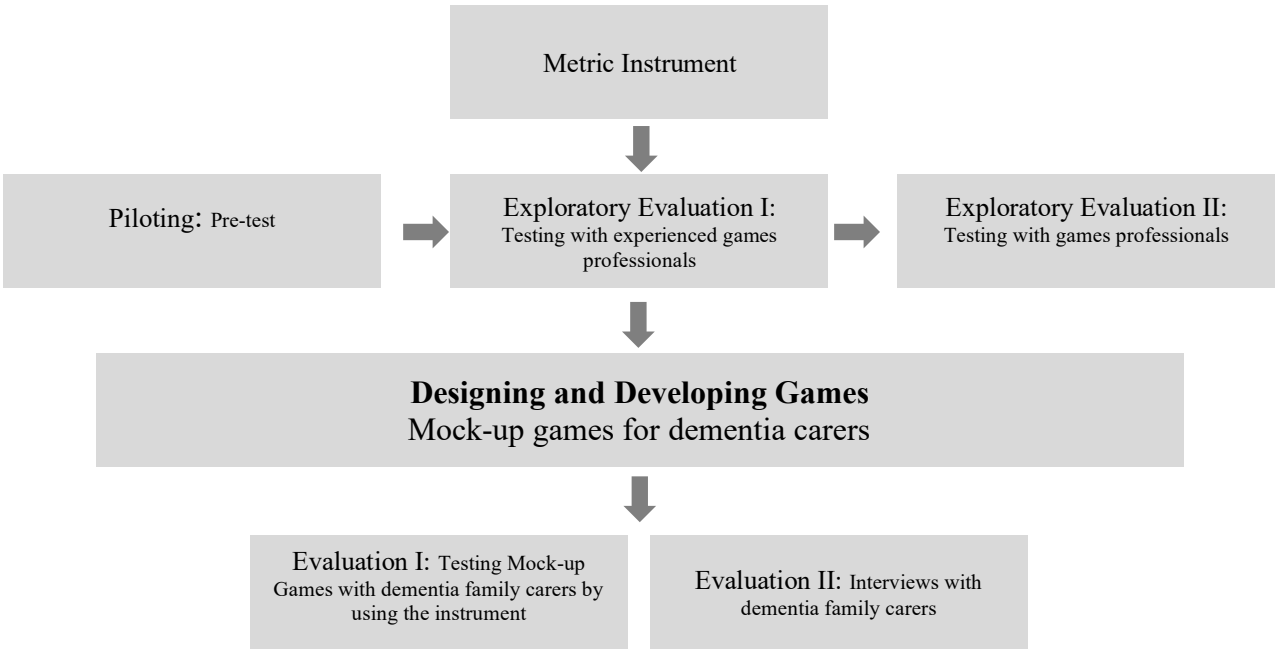

Figure 6.12: Framework Game Experiment Progression

6.2.1 Development Metric Instrument

The initial development of the framework involved creating two tables; firstly, a metric table based on the framework elements and game contents, and secondly, a GQM (Goal-Question-Metrics) table derived from the first table.

Purpose: To develop an instrument to measure the framework elements reliably. The GQM table is for designing the software metrics will be used to structure and devise this instrument.

Method: The instrument was made using the GQM method (Goal-Question-Metric) according to the framework elements, grouped into the three components (Health, Education and Social) combined with the three platforms (Social marketing, Social media and Games). Moreover, five components of games content are included; Game play, Avatar portrayal, Game world graphics, Sound/Music and Storyline. The game content is described in **Table 4.5**, and applied in the game analysis in **Chapter 6.1**.

Procedure: The instrument was developed by game content and framework elements include components and platforms in two steps. Firstly, a metrics table was set up based on the framework elements and game content (shown in **Appendix E**). Secondly, a GQM table was set up (shown in **Appendix F**).

6.2.2 Piloting: Pre-test

The piloting aimed to use four reviewers to uncover potential flaws. Ethical approval for the interviews was granted by the University of Southampton's ERGO committee (Reference number ERGO/26277).

Purpose: To uncover issues from the reviewers before the main experiment, relating to the games chosen, timing issues, questions and so on.

Method: The reviewers, including some academic researchers, provided feedback on various aspects, in order to identify which games to use, and to test and refine the metric questions.

Procedure: In this study, the reviewers were asked to review six games each and to set aside time to test the procedure of the main experiment. They were also asked to clearly review each of the required questions.

Data collection and analysis: The reviewers provided feedback on the choice of games and the metric questions. Based on the reviewers' feedback, final decisions were made on the games and questions for the next experiment, which was to be tested with experienced gaming professionals.

6.2.3 Exploratory experiment

The aim of the exploratory experiment was to test existing games with game professionals. The first stage of this involved testing various games with experience game professionals; the second stage was to, based on the experienced game professionals' results, select a game to test with large number of games professionals to gather quantitative data.

6.2.3.1 Exploratory experiment I: Testing games with experienced game professionals

This stage involved testing a selection of six games, using the created instrument. The games were tested by games industry professionals with five participants (game developers, designers or researchers). Ethical approval for the experiment was granted by the University of Southampton's ERGO committee (Reference number ERGO/30888).

Purpose: This stage was to show the metrics' reliability and the industry professionals' points of view, to help to expand the framework for future research. The metric survey was to get game developers, designers and researchers to use the metrics with six games and analyse the results to see if they can use the metrics reliably. This study was focused on games.

Method: Involved game designers, developers and researchers using the metrics with six games to give informed opinions about games for change.

The games were chosen based on their being related to games for change, especially for health, as below:

- Re-Mission[13]: The game is designed to aid a young patient's psychological health, made for people who have cancer and their families, to understand the positive ways to fight cancer with different treatments.
- Cancer Game[14]: This game displays the symptoms and causes of cancer, and gives knowledge of health behaviours.
- Sea Hero Quest[15]: An Alzheimer's Research game to help global research into dementia.
- Life in a Spin[16]: The game is for practical support and advice for young adult carers. The game is about balancing caring with your everyday life.
- The Dysphagia Game[17]: This game was developed with the NHS, and gives knowledge of dysphagia.
- NHS Nene CCG[18]: This game shows the NHS services for different health situations to help people and carers when they are unwell.

Procedure: The participants were given a survey questionnaire split into two parts:

- **Part One: Metrics applied to the game**. The survey comprised of six games and their respective questionnaires. The participants were asked to play each game for five minutes, and then complete their respective questionnaires with thirty questions, which took about five minutes each to complete. The questionnaire consisted of multi-choice questions designed for subsequent metrics development.
- **Part Two: Metric applied to the evaluation of framework components**. This part was based on the framework, including the three components of the carers' needs (Health, Education and Social) combined with the three platforms related

[13] http://www.re-mission2.org/games/. *Six games to fight cancer.,* ReMission2.
[14] http://veevia.com/playgame/cancergame.html. *Cancer game.,*Cafa/ Experimental multimedia studio.
[15] http://www.seaheroquest.com/en. Sea Hero Quest.
[16] http://lifeinaspin.org/scenarios/school.
[17] http://mynutilis.co.uk/game. *The Dysphagia game.,* Nutricia.
[18] http://www.neneccg.nhs.uk/play-our-nhs-game/ *Nene.,* NHS.

to games for change (Social marketing, Social media and Games). This part had six questions, designed to collect feedback about how to address the components from the framework in terms of actual games.

Data collection and analysis: The respondents were experienced game professionals who gave feedback about games for change. The data collected was the questionnaire results; this feedback was measured by a set of metrics created to assess how closely a dementia game follows the principles of the framework. The data was analysed with the IBM SPSS software.

6.2.3.2 Exploratory experiment II: Testing a game with game professionals

Exploratory experiment II involved testing the game with the most successful results from Exploratory experiment I. The thirty-five participants included game artists, designers and developers. Ethical approval for the experiment was granted by the University of Southampton's ERGO committee (Reference number ERGO/30889).

Purpose: This stage attempted to get data from a large sample in order to measure the metrics' reliability. While Exploratory experiment I was focused on the games, Exploratory experiment II focused on testing whether the metrics were reliable.

Method: This exploratory experiment was similar to the previous one; using the metric questions to test the highest-rated game from the results of Exploratory experiment I to test with game artists, designers and developers.

Procedure: The participants needed to play the chosen game for ten minutes and complete a multiple-choice questionnaire in ten minutes.

Data collection and analysis: The respondents were professionals in the game industry, and the data collected was from the set of metrics in the questionnaire, created to assess how the game follows the principles of the framework. The data analysed was with the SPSS Statistics application.

6.2.4 Design and Develop game: Make a Cup of tea

A game was designed and developed, according to the framework, in order to help family carers.

Purpose: The main purpose of the game was to deliver knowledge of health issues about understanding dementia and information about caring for dementia patients, acting as an entertainment platform to support dementia family carers at pre- and early-stages.

Materials: The graphics were designed in Adobe Illustrator, Photoshop, and Flash. The mock-up game was produced as a video.

Procedure: The game was designed according to the framework, which also included refinements from Exploratory experiments I and II. A game concept document was produced, containing the five key messages of dementia, the game type, game story and the information about dementia care. A design document was drawn up to show the gameplay, avatar portrayal and game-world graphics.

Development of the mock-up game: "Make a cup of tea" Contains five mini-games, which are played in order to complete the task of making a cup of tea. In British culture, making a cup tea is part of daily life, which the majority of people find easy to achieve without thinking. However, thinking about the process makes it more complex; consequently, people with dementia find it increasingly problematic in their everyday tasks. The five mini-games help to illustrate the five key messages about dementia explained on the website from the organization Dementia Friends and five pieces of information to suggest to caregivers for dementia.

6.2.5 Experiment I: Testing the game with dementia family carers

This stage aims to test the game with twenty dementia family carers using qualitative research methods with twenty participants. According to G*Power, the minimum sample size calculated was fifteen (**Figure 6.13**). As the study focused on a broader, observable effect, a large effect size of 0.8 was chosen, as well as an alpha value of 0.05 and a Power value of 0.8 according to general practice (Cohen, 1992). Convention is 0.05 however when exploratory field is 0.1, required sample size = 16. Ethical approval for the experiment was granted by the University of Southampton's ERGO committee (Reference number ERGO/40556A1).

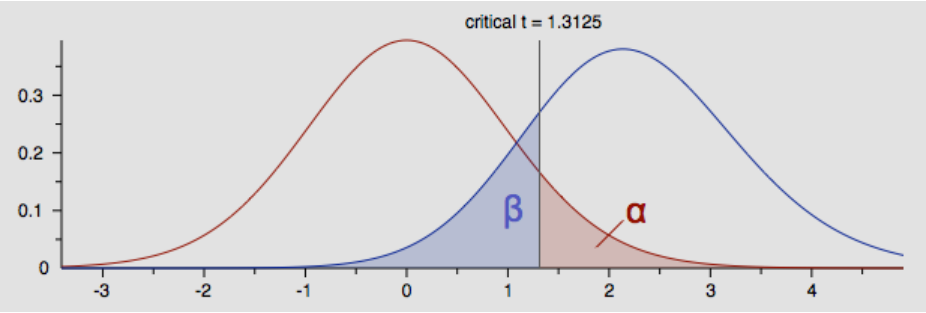

Figure 6.13: G*Power statistical test

Purpose: To test the game with dementia family carers using qualitative methodology to measure the reliability of the game for dementia family carers.

Method: The respondents were British dementia family carers. The survey questions were derived from the created instrument, which was also applied in the previous experiment with experienced gaming professionals.

Procedure: The participants were asked to play the game or watch a video for five minutes, and then complete the respective questionnaire in **Appendix F**.

Data collection and analysis: The respondents, dementia family carers, generated qualitative data, with over thirty participants taking part in this study. The data was used to measure the reliability of the game for dementia family carers, especially those involved in pre- or early-stage dementia.

6.2.6 Experiment II：Interviews with dementia family carers

Interviews with twelve dementia family carers constitute quantitative research methodology, used here to uncover usability problems of the mock-up games. Ethical approval for the interviews was granted by the University of Southampton's ERGO committee (Reference number ERGO/44530).

Purpose: This stage aimed to collect feedback on the mock-up game from dementia family carers; the dementia family carers would be able to give direct, in-depth feedback about how the game can support dementia family carers dealing with pre- or early-stage dementia.

Method: The interviewees were dementia family carers in Hampshire, UK. The interview consisted of general open-ended questions focused on the mock-up game.

Procedure: In these studies, in order to demonstrate the mock-up game, the interviewee was allowed to play the game for ten minutes. After gaining an understanding of the mock-up game, the participants were interviewed with open ended questions about the game itself and suggestions for future expansion in **Appendix G**.

Data collection and analysis: The interview data was collected from dementia family carers, especially main carers. The respondents with dementia families provided feedback on the mock-up game. The software NVivo 11 for Mac was used to assist this analysis.

6.3 Development the Metrics Instrument

An instrument was developed, using the GQM (Goal-Question-Metric) method, according to the metric table based on the framework elements and game content (shown in **Appendix E**). The full outcome of using the GQM method (the goals, questions and metrics) is shown in **Appendix F**.

6.3.1 Development Metric table

The metric table was based on the framework elements and game content. The framework elements included the framework components (Health, Education and Social) combined with the games for change platforms (Social marketing, Social media and Games). The game content based on the game analysis in **Chapter 4.2.2** included Gameplay, Avatar portrayal, Game world graphics, Sound/Music and Storyline (refer to **Table 4.5**). The table was created in order to assess how closely a dementia carer game follows the principles of the framework. The game analysis in **Chapter 6.1** formed the basis of the instrument.

Gameplay

Game play is further divided into three subgroups, namely support, message and collaboration (Charles, 2005). Game support is linked with game purpose including three components in the framework which comprise health, education and social. Game

message includes game feedback and message driver for play. Game collaboration is the game's connection to and cooperation with other platforms in order to increase the social component.

Parameter: Game support - with more than one support

- Game educated players to increase their knowledge of health
- Social media as an online community to support health
- Game as a platform to engage players and improve their health
- Social elements in the game to support the community to spread the knowledge
- Game shows multiple ways to solve the problems, and also involve other players' views
- Social marketing with game to raise awareness

Parameter: Message - Game feedback, message and information links with the game purpose

- Give the message/information as education components to achieve changes in health behaviour
- Game's message/information links with community to support health
- Community encouraging players to discuss the game's message/information and improve player health
- The game's message/information links with communities to encourage player education
- Game's message/information can be discussed with other players
- Game's message/information encourages the player to produce social components

Parameter: Collaboration - Game combined with other platforms

- Game collaboration with education components to help players understand the health issues
- Game links with social support to discuss player's health issues
- Game uses engagement to improve health

- Game collaboration with social media to increase the size of communities to encourage education components
- Game engages players to inform educational components
- Game provides a chat room, game community, email/messaging, "buddy list" or link to a social networking website

Avatar Portrayal

Avatar representation of the personalisation, appearance and behaviour of the character (Burgess, et al., 2007). The player may be able to modify their avatar by gender selection and features, and also personality traits.

Parameter: Avatars give the meaning message

- Game gives the message for changing health behaviour through avatar characteristics
- Avatars engage other players, creates a group psychological effect which allows players to interact and share common health behaviour
- Using avatars to engage communities and improve health
- Using the avatars links with social platforms to encourage player education
- Avatars can be social components to engage users and inform education
- Avatar portrayal to engage player produces social components

Game world graphics

The graphics display game content by colour, symbol and 2D/3D etc. (Kastrup, 2006). The graphic could also be related to the culture. For example, blue represents trust, security. But it can also represent depression, loneliness. Game world realism is about how realistic the scenes are depicted graphically.

Parameter: Game world shows a realistic environment

- Game world shows real-life or real situations involving the health issues
- Game world with real community support to change health behaviours
- Game world engages people with health behaviours
- Game's world presented to real-life and using the social community to inform education

- Game world gives information that would be useful in real life
- Game word encourages similar types of player to produce communities

Sound/ Music

This concerns the background music and sound effects of the game (Collins, 2008). It also includes the background voice guide or multiplayer discussion in game.

Parameter: Background music including the voice and sound supports the game with more meaning

- Background voice gives meaningful health messages
- Game can share the players' voice to support health
- Background music can encourage players to improve their health
- Social voice encourages players to get knowledge
- Background voice/music can encourage players to get knowledge
- Background music/sound is able to encourage players to produce communities

Storyline

This concerns the storyline to invite the player and maintain their interest in playing the game (Crawford, 2003).

Parameter: Storyline keeps the player engaged in the game

- Game story educates the player and changes health behaviour
- Game story with the social components to keep the players engaged
- Game story is able to encourage players to improve the health
- The storyline is entertaining enough to keep the player interested in the game, using plot twists, conflict and interesting characterization
- Game story can engage players, informing the education components
- Game story engages players, increasing the size of the person's community

6.3.2 The instrument applied to the game

The instrument was created using the GQM (Goal-Question-Metric) method for designing software metrics. Likert items for each of the metrics were chosen to be used as a quantitative method to measure the player's feedback. A set of fifty-six items was

applied to the six games evaluating the framework elements in Exploratory experiment I, and one game with six items evaluate of framework elements in Exploratory experiment II. The Likert items are described below (refer to **Chapter 4.2.2**; **Table 4.4**).

Health

The purpose with the health-related game is to measure the extent to which it can increase the carer's ability to manage their lives better, which then improves health and wellbeing (Kühn, et al., 2018). Games for health can influence both physiological and psychological improvement. It has the potential to collaborate with different purposes such as educational and social. For example, increasing the knowledge of health issues or expanding the online community can allow people to benefit from openly discussing and sharing their respective experiences.

Goal: To evaluate how education strengthens the Health component

- While playing, I gained new knowledge from the game's message/information section about how to improve health.
- *The game's message/information does not give enough information about health issues.
- *While playing, I don't feel the game educated the player about the health issues.
- Adjusting the characteristics of the game's avatars could change the players' health behaviour.
- I felt the game was related to real life situations which involve health issues.
- I don't think building a realistic environment is necessary to help understand the health issues the game is trying to indicate.
- The game's background music/sound got in the way of understanding the health issues.
- The game's background narrator or commentator gave supporting information about the health issues.
- After I play through the game's story, I understand more about health issues.
- After I play through the game I do not think I will change my health behaviour.

Goal: Evaluate how social media supports the Health element

- Playing the game in combination with social media platforms can help support people with their health issues.
- I don’t think using the online community will be able to support people with their health issues.
- The game allowed me to link with communities to discuss the health issues.
- *The game does not facilitate the with community members to discuss the health issues.
- Using an avatar whilst playing the game helps to bring me closer to the community.
- I feel that by using my avatar within the community helps me to change my health behaviours.
- I think the game world encourages players to seek out real-world communities to find support for their health issues.
- In the game, I was allowed speak to other people about health issues.
- I felt the game story made me interested in finding out more about health.
- Whilst playing the game, I don't focus on the game story.

Goal: Evaluate engagement improve Health element

- I think the social aspects of the platform help to engage with other people to improve health.
- *The platform did not allow engagement with the community in order to improve health.
- *I did not find the game engaging enough to improve healthy behaviour.
- While playing, I found the game elements (avatars, graphics and music) can change our behaviours.
- While playing the game I found the game elements (avatars, graphics and music) can engage people with the health issues.
- * Whilst playing the game, the game world encourages people to engage on health issues.
- *when playing the game, the background music does not help engage people in the health issues.

- While playing, I felt motivated by the game story to improve my health behaviour.

Education

The purpose with the Education game is to measure the extent to which it can enhance the player's knowledge, conveying useful and informative messages during the game (Wols, et al., 2018).

Goal: Evaluate Social element encourages Education component

- I found the social platform associated with the game helped me discuss issues with the communities.
- I don't think the game provides new things to learn.
- I felt the social platform associated with the game increased the size of communities through which I can discuss the issues.
- I found using an avatars helped me connect with social media.
- I found using the asocial media platform associated with the game enabled me to get more information.
- I found that the game world represents real life issues.
- I found that the game world involving social communities allowed me to be informed about the issues.
- I think the background music and sound helped be related to the education.
- The background narrator or commentator supplying more information.
- I felt the game used plot twists, conflict and interesting characterization to make it more interesting.

Goal: To Evaluation engagement informs education element

- I found the game shows different ways to handle real life issues.
- The game's message is interesting enough to discuss with other people.
- I don't think the gameplay can engage people to get new knowledge.
- I found the avatar can motivate other players to discuss issues.
- The game world graphics and background music give new knowledge about the real world.

- *I don’t feel the background music and sound will help motivate people to obtain new knowledge.
- After I play a game, I would discuss the issues with other players.
- After I played a game, through discussing the issues with other players, I made friends.

Social

The effectiveness of the social game is measured by looking at how the game cooperates with other platforms such as websites, social media or local communities, in order to form supportive environments that promote sharing and open up discussion(Canossa, et al., 2019).

Goal: Evaluate engagement produces social component

- I found the game can raise social awareness of the issues.
- I think social is very important in game’s element
- I don't think the game’s social component help raise awareness.
- I think the game’s message and information lead to people becoming involved in the community.
- I don’t feel the game’s t social media encouraged players to get deeply involved with each other
- The avatar and game world helped me to connect with other players of similar styles of avatars.
- I don’t feel the game world helped players grow the size of the communities.
- I think the background music and sound helped to link with other players in the game.
- I found the game story helped me to discuss similar interesting issues with other players.
- I found that discussing similar interesting issue with players helped increase the size of the community.

6.3.3 The instrument applied to the evaluation of framework elements

Based on the framework elements, including the three components of the carers' needs combined with the three platforms related to games for change. A set of six questions was designed to collect feedback about how to address the components from the framework in terms of actual games.

Health

- I believe education in game is important to strengthen health knowledge. For example, games can educate players about understanding their health.
- I believe social platforms can support health (for example, communities can support health by providing information or talking therapy).
- I believe engagement improves the health element, such as engaging the player deeply so they can understand their health.

Education

- I believe social media encourages education, such as communities bringing discussion of different issues.
- I think engagement can inform education. For example, to engage people to deeply understand the specific issues.

Social

- I believe engagement promotes social component. For example, by encouraging players to become involved in communities.

6.4 Chapter Summary

Games analysis confirmed the framework; clarifying the components of dementia carers needs and Games for Change's platform; also identifying the game as a main platform for Games for Change. Thus, games are the main focus in this research. The methodology for developing an instrument based on the framework; this involved gathering qualitative and quantitative data for designing games for dementia families carer with seven phases, including developing the instrument, piloting, exploratory evaluation, testing a mock-up game and interviews with dementia family carers. The instrument was developed based on the framework and game content. The piloting was

conducted to uncover the potential flaws. The exploratory experiment had two stages; testing six games with game experience professionals to analyse the games, and testing with up to thirty games professionals to measure the instrument metrics' reliability. Following this, a game was designed and developed based on the framework and the results of the exploratory experiments, in order to test the instrument with dementia family carers and get their feedback from interviews. The metric table was based on the framework components and game content. The instrument was created using the GQM method in order to evaluate of the framework elements in further experiments, which applied the game and evaluation of framework elements. The following chapter explores the piloting, uncovering the potential flaws of the instrument, including reviewing the metric's goals and questions. It also describes the exploratory experiments for testing games with game professionals using the instrument, to measure its reliability.

Chapter 7. Piloting and Exploratory experiments

In the previous chapter, an instrument was developed to measure games for supporting dementia family carers. This chapter discusses the piloting and exploratory experiments.

7.1 Piloting: Pre-test

The purpose of piloting is to uncover the potential flaws of a planned experiment. The reviewers' feedback is valuable in shaping the format of the final stage. The experiment was piloted with academic researchers from universities in the UK. In total, four reviewers with different areas of expertise were sought for the piloting. The reviewers were chosen based on their academic experience with over two years.

7.1.1 Piloting Process

The piloting had three purposes. The first purpose was to gain clear feedback of the six games chosen to be tested with the participants; The games were chosen because they were related to games for change, especially for health issues to support carers (**Table 7.1**). In this project, practical research will be combined with theoretical knowledge transfer and applied to the specific strategically innovative project with a strong theoretical foundation. Thus, games were chosen for evaluating the instrument and the following experiment (Jiang, 2018). Three games were analysed is part of the confirming framework. The three other games were subsequently analysed using the same method. These games were analysed by category in **Table 7.2** and by content in **Table 7.3**. These games were chosen because they related to health and education purposes from the carer's perspective. The second purpose was to make sure participants have a suitable length of time to complete the study. The final purpose was to check that the questions can elicit a deep understanding of the participants' point of view and dementia carers' needs. The piloting survey is shown in **Appendix G**.

Table 7.1: Games Chosen

Name of Game	Describe
Re-Mission[19]	The game is designed to aid a young patient's psychological health which is made for people who had cancer and their families to understand the positive ways to fight cancer with different treatments.
Cancer game [20]	In this game display the symptoms and causes of cancer, and gives knowledge of health behaviours.
Sea Hero Quest[21]	This is an Alzheimer's Research game in order to helping global research into dementia.
Life in a Spin[22]	The game is practical support and advice for young adult carers. Game balance caring with your everyday.
The Dysphagia Game[23]	This game was developed with the NHS. This game gives knowledge of dysphagia.
NHS Nene CCG[24]	In this game shows the NHS services for different health situations to help people and carers when they are unwell.

7.1.2 Games chosen

The games chosen demonstrate the Health, Education and Social components of the framework. These include three games from **Chapter** 6.1, and three other games preferred by the health sector. From the reviewers' feedback, these games allowed players to understand the disease in different ways, as well as explore the causes through experimentation and problem solving, which can raise healthcare awareness. However, the games' subject depends on preference. The aims of this study are focused on how reliable the metrics are for games professionals, and how to support dementia carers. For these reasons, healthcare is the main subject to test, which is involved with the framework components of health, education and social. In addition, the reviewers mentioned that the games chosen to test the metrics are reliable. The different game types are focused on the health issues.

[19] http://www.gamesforchange.org/play/re-mission-2/
[20] http://www.gamesforchange.org/play/cancer-game/
[21] http://www.gamesforchange.org/play/sea-hero-quest/
[22] http://lifeinaspin.org/scenarios/school
[23] http://mynutilis.co.uk/game
[24] http://www.neneccg.nhs.uk/play-our-nhs-game/

7.1.3 Timing issues

Five minutes were given to the participants to play each game, in order to give a general idea of the games. Testing with game professional lasted around one hour in total. The participants were scheduled five minutes to complete the questionnaire, which turned out to be not enough time. In this case, it was decided the participants could take five to ten minutes to complete the questionnaire. While it might take longer, the participants do not have to test the games at the same time. Due to tester engagement in minutes being reflective of educational message, the maximum time to play each game was changed to ten minutes.

7.1.4 Questionnaire

According to the reviewers, the questions were not clearly categorized. As a result, participants may not able to understand the goal of questions. (e.g. Why are you asking these questions? What do you know from these questions?). As such, it was important to illustrate these categories to make these questions clear. Thus, these questions were separated into 3 main sections corresponding to the framework elements (Health, Education and Social).

Even though one reviewer suggested using a 4-point Likert scale for the questions to clearly establish their side, the "Neither" rating is important in this study. In the previous study, the expert interviews used a 4-point scale in order to encourage a committed opinion. This study used general questions, and so needed to provide more options for the participants.

In general, the questions were found to be simple, easy to read and understandable, but some questions were not clear and needed repeating. The reverse-worded questions were found to make participants confused, because the scale numbers were also reversed. As the reverse-worded questions are important to keep to help ensure reliability, it was decided to remove the scale numbers, and leave the answer boxes blank, to avoid confusion.

One suggestion was to use open-ended questions in the questionnaire to evaluate the framework elements, to allow the participants to give more detailed feedback.

Nevertheless, this experiment was about collecting quantitative data, as opposed to the previous expert interviews, which were about gaining a deeper understanding of carers' needs. The survey questions for game professionals are general questions to evaluate the framework elements.

7.2 Exploratory experiments

The purpose of the exploratory experiments was to test existing health games with game professionals. This phase consisted of two stages; firstly, to test various games with experience game professionals, and secondly, to select a game to test with a large number of professionals, based on the results of the first stage, to gather substantial quantitative data to validate the instrument.

7.2.1 Exploratory Experiment I: Testing games with experience game professionals

Testing the games with experienced game professionals involved two parts (**Appendix H**). The first part involved the metrics being applied to each game with respective questionnaires containing six questions each. The second part involved the metrics applied to the evaluation of framework elements on a single game, to collect feedback on how to address elements from the framework in an actual game. The participants were required to be game developers, designers or researchers, with over three years' experience.

7.2.1.1 Metric applied to the games

The survey comprised of six games and their respective questionnaires. The six games included the following (the analysis of games in **Table 7.2** and **Table 7.3**, according the **Table 4.2, 4.3** and described further in **Chapter 7.3**): **Game 1:** Re-Mission[25]; **Game 2:** Cancer Game[26]; **Game 3:** Sea Hero Quest[27]; **Game 4:** Life in a Spin[28]; **Game**

[25] http://www.re-mission2.org/games/. *Six games to fight cancer.,* ReMission2.
[26] http://veevia.com/playgame/cancergame.html. *Cancer game.,*Cafa/ Experimental multimedia studio.
[27] http://www.seaheroquest.com/en. Sea Hero Quest.
[28] http://lifeinaspin.org/scenarios/school. Life in a Spin

5: The Dysphagia Game[29]; **Game 6:** NHS Nene CCG[30]. The participants were asked to play each game for five minutes. Then were then requested to complete their respective questionnaires, containing six questions per game (fifty-six in total).

Table 7.2: Game analysis by Category

Name of Game	Health	Education	Social	Genre	Platform
Re-Mission	1 Gives a player a positive way to face their problems and fight cancer.	1 This game shows different types of cancer and the treatments used, along with its effect on the body.	0	Shooting	Online / Mobile
Cancer Game	0.5 The message this game aims to deliver is how to live well.	1 The game's levels are comprised of different body parts and show the user how to look after each organ	0	Adventure	Online
Sea Hero Quest	1 Helps improve people's navigational skills.	0	0.5 Users can share their score on their social media account, but does not include its own community within the game.	Adventure	Mobile
Life in a Spin	1 Discussed how to balance healthy life as a carer	1 Explain people's life as a young adult caregiver	0.5 Discussed social life in game	Simulation	Online
The Dysphagia Game	1 Discussed health issues of dysphagia	1 Improve knowledge and management of dysphagia	0.5 Increase awareness of dysphagia. It also develops a board game for multiplayers	Adventure	Online / Card game

[29] http://mynutilis.co.uk/game. *The Dysphagia game.,* Nutricia.
[30] http://www.neneccg.nhs.uk/play-our-nhs-game/ *Nene.,* NHS.

NHS Nene CCG	1 Provide information on health issues	0 A self-assessment game. Also increases knowledge of where to get support	0.5 Link with NHS website only provides information	Adventure	Online

Table 7.3: Game analysis by Content

Name of Game	Gameplay	Avatar portrayal	Game world graphics	Sound/Music	Storyline	Total Score
Re-Mission	7 There are different tools for players to choose from to kill the cancer cells. Different types of cancer have different treatments.	4 The players cannot choose their own character, however they can choose where to fight the cancer cells within the human body.	7 The graphics depicted the cancer cells as evil but not in a scary way.	6 Sound effects are similar to other shooting games. The background music enhances the dark atmosphere such that players become more focused on shooting the cancer.	7 This game educates the players on different forms of cancer and their respective treatments.	**31**
Cancer Game	5 There are different roles for players to play within the game. However, the target of each level of the game can be confusing sometimes.	2 There are different characters for the players to choose from, but the players cannot alter the details.	7 Designed to look like a factory in a cartoon style.	6 Adopts noises from real factories such as running machines to make the game closer to the actual environment.	7 There are five levels which show different stories of the body organs. The main story is about how to live well and healthy.	**27**
Sea Hero Quest	7 Consists of different targets for the players.	5 Before the game it asks for personal information; there are not many options at the beginning of the game until the players win	8 The design is simple and quick to understand. The symbols link the user to the real world, such as the sea, Iceland etc.	7 The background music is atmospheric and adds to the authenticity of the experience. For example, the driving of the boat in the game is accompanied .by a sound effect.	8 The game highlights the problems dementia sufferers have with navigation, and aims to train the user's brain in this respect. Non	**35**

		each mini-game.			dementia sufferers .are encouraged to play too.	
Life in a Spin	6 A multi-tasking game for young carers to help balance their life.	4 There are no Avatars to choose. However there are four plate (part). Discusses how to manage your time and balance your life.	7 Games design with real environment, discusses the real life issues.	8 The background voices guide the game play and describe the decision player made which affects their life.	4 Games within four task to balance their life as a carers.	**29**
The Dysphagia Game	5 Easy to play, provides information about Dysphagia. However, there is not enough entertainment.	1 The game has avatars but there is no option to choose which avatar.	8 The game format is based on the traditional Snakes and Ladders, changed to fork and spoon.	2 There is no background music in the online game. However, in the board game players are able to discuss with each other.	6 The game is easy to understand and simple to play and discusses Dysphagia issues. It is for the health and social care setting.	**22**
NHS Nene CCG	4 The game is very simple as a self-assessment game but is not entertaining.	0	5 The game has a simple design as an assessment.	2 There is no background music. However, team players be can discuss health conditions in the game.	9 The game shows how to deal with different emergency situations.	**20**

Normality test

Before comparing the data, it was necessary to determine whether the sample data was normally distributed, as this would affect what test was needed to perform the comparison. The results shown in **Table 7.4** were used to check the participants' data for normality. The Kolmogorov-Smirnov and Shapiro-Wilk tests had significant results ($p<0.05$) for Health_Education, Health_Engagement and Social_Engagement, indicating that data was not normally distributed. A t-test was therefore not considered appropriate to compare the means, since such test would assume that the sample

distributions of the data are normal. For this reason, an alternative non-parametric test was used to compare the means, as this does not presume the data distribution to be normal.

The null hypothesis and alternative hypothesis being investigated were:

H_0: The mean ranking of each item is not different from its corresponding null value.

H_1: The mean ranking of each item is different from its corresponding null value.

Table 7.4: Normality test

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Health_Education	.159	30	.050	.881	30	.003
Health_Social	.075	30	.200*	.974	30	.649
Health_Engagement	.162	30	.044	.903	30	.010
Education_Social	.158	30	.055	.937	30	.073
Education_Engagement	.142	30	.129	.956	30	.251
Social_Engagement	.168	30	.031	.923	30	.031

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Non-parametric means test

SPSS nonparametric tests are mostly used when assumptions aren't met for other tests. Additionally, nonparametric tests are suitable for ordinal variables too. In rare cases they may have more statistical power than standard tests. The Mann-Whitney test was selected as an alternative, due to its equivalence to the t-test. By applying a non-parametric means test (**Table 7.5**), the responses from the five participants who participated in six games were compared against a null value. The null value was calculated from the sum of "Neither" (Neither = 3), which on the Likert scales was represented by the value 3. The averaged responses from the five participants with six games equals 30 data in total (N=30), for each aspect was compared against a predefined "null" value. The group is represented by different amounts of questions; this will affect the mean rank value.

The Mann-Whitney test did not show a significant result ($p>0.05$), meaning that the result could happen due to chance. The relevant result would not impact the study's results. In this study, a small number of participants was used, so the results did not constitute strong proof for the metrics table to be reliable.

Table 7.5: Mann-Whitney test

Ranks

	Group	N	Mean Rank	Sum of Ranks
Health_Education	Null	30	27.50	825.00
	Participants	30	33.50	1005.00
	Total	60		
Health_Social	Null	30	33.00	990.00
	Participants	30	28.00	840.00
	Total	60		
Health_Engagement	Null	30	27.50	825.00
	Participants	30	33.50	1005.00
	Total	60		
Education_Social	Null	30	32.00	960.00
	Participants	30	29.00	870.00
	Total	60		
Education_Engagement	Null	30	30.50	915.00
	Participants	30	30.50	915.00
	Total	60		
Social_Engagement	Null	30	30.50	915.00
	Participants	30	30.50	915.00
	Total	60		

Test Statistics[a]

	Health_ Education	Health_ Social	Health_ Engagement	Education_ Social	Education_ Engagement	Social_ Engagement
Mann-Whitney U	360.000	375.000	360.000	405.000	450.000	450.000
Wilcoxon W	825.000	840.000	825.000	870.000	915.000	915.000
Z	-1.424	-1.215	-1.446	-.717	<.001	<.001
Asymp. Sig. (2-tailed)	.154	.225	.148	.474	1.000	1.000

a. Grouping Variable: Group

Six games results with Mann-Whitney Test and Test Statistics

The Mann-Whitney test results of the games grouped together is shown in **Appendix I**. The results of the Mann-Whitney tests for each individual game is shown in **Appendix J**. Based on the individual results, Game 1 showed a focus on *Health with Engagement* and *Education with Engagement*. There were positive results across all the component/element combinations for Games 2 and 4. However, *Health with Social* did not rank highly in any of the games. Games 2 and 4 were regarded as entertaining, meaning more able to attract with players. Game 3 ranked highly on *Health with Education* and *Health with Engagement*. Game 5 showed high rankings in *Health with*

Education and *Social with Engagement*. Game 6 did not have high rankings; nonetheless, the game had the same value as the Null group (Null = 3 "Neither") on the components of *Health with Social*, suggesting neither agreement or disagreement with its presence.

The Mann-Whitney results showed each game's purpose. However, the test had insignificant results. Thus, testing with large number of participants was required to show significant results to prove the metrics to be reliable.

7.2.1.2 Metric applied to the evaluate framework element and components

The survey was based on the created framework, including the three components of carers' needs (Health, Education and Social), and the platforms related to games for change (Social marketing, Social media and Games). The purpose of this survey was to collect feedback about how to address those elements from the framework in terms of actual games.

Normality

Normality tests were performed on the participants' data to check its normality. The Kolmogorov-Smirnov and Shapiro-Wilk tests had significant results ($p<0.05$), which means the data was not normally distributed. In this case, as the sample distribution of the data was not normal, comparing the means by using a non-parametric means test was considered appropriate.

Non-Parametric Means Test

The metrics applied to the elements had significant results ($p<0.05$) in the Mann-Whitney test, which means the result would not have happened due to chance. For each of the questions, the mean rank was higher than the null value (Null = 3 "Neither"). The averaged responses from the 5 participants (N=5).

7.2.2 Discussion

The Mann-Whitney test did not show a statistically significant result ($p>0.05$). In this case, what needs to be evaluated is the quality data. A test with five professionals proved insufficient to obtain significant results about the metrics. Therefore, increasing the

sample size to over thirty participants should help to achieve significant, reliable results (Silver & Lewins , 2010).

The majority of the games were focused on one purpose, while other purposes could exist as additional support. The social component is complex; it includes online and offline aspects (i.e. real life). For example, the online social component can help players to talk to each other, or even to make friends. On the other hand, the offline element can potentially increase the social community size in real life. Consequently, both aspects might help each other. The ideal social component is a combination of online and offline aspects.

In this research, the games themselves were analysed. The social component can constitute additional support, with Education and Health forming the key components. The social components of games for change for dementia carers could include social marketing and social media; this is due to the fact that social marketing has the potential to increase awareness of dementia issues, and social media can form a platform for players to share experiences and to assist each other.

In order to collect quantitative data to establish the reliability of the metrics, exploratory experiment Ⅱ aimed to test the *Cancer Game* with game professionals with over one year's experience as designers, developers, artists, etc., in the game industry. The *Cancer Game* was applied in the Education and Health components to strengthen the metrics' reliability by applying them to over thirty participants.

The following question was added in the Education section of the questionnaire: "To evaluated Engagement informs the Education component". In this section, Game world graphics and Sound/Music's results were did not have a higher mean rank than the Null group, so the following questions with the same goal were changed (see **Appendix K**).

G43: The game world graphics and background music give new knowledge about the real world.
Changed to:

- I found the game world graphics helped me to gain new knowledge about real-life health issues.

- I think the game world graphics represent real health issues.

G44: *I don't feel the background music and sound will help motivate people to obtain new knowledge.
Changed to:

- I feel the game's background music and sound can help motivate people to obtain new knowledge about health issues.

7.2.3 Exploratory Experiment II：Testing a game with game professionals

This stage involved testing a game, *Cancer Game*, using the instrument metrics. The games were tested by games industry professionals, such as game artists, game developers and designers with over one year's experience.

7.2.3.1 Metrics applied to the games

The study comprised of playing the *Cancer Game* and filling out a questionnaire. The participants were asked to play the game for ten minutes, and then complete the respective questionnaire with fifty-seven questions, which took about ten minutes to complete. This study involved thirty-five participants.

This study involved testing the created metrics, derived from the framework's Carers' Needs components combined with the Games for Change's platforms and five pieces of game content, with Engagement as the main element.

In the framework, the Carers' Needs elements included the Health, Education and Social components, and the Games for Change elements included the Social marketing, Social media and Games platforms. The game content included Gameplay (support, message, and collaboration), Avatar portrayal, Game world graphics, Sound/Music, and Storyline. In this study, each question addresses at least one element; certain questions address two elements, due to being equally relevant to each. Of the fifty-seven questions in the questionnaire, twenty-eight questions are concerned with the Health component, twenty-nine questions relate to the Education component, and thirty questions are involved with the Social component. The metric questions relate to Engagement as a metric goal, with twenty-seven questions relevant to it.

Normality

Normality test also discussed in pervious experiment in **Chapter 7.2.1.1.** The Kolmogorov-Smirnov and Shapiro-Wilk tests were used to test for normality, with element and component question groups showing significant results ($p<0.05$). This means, in the context of this particular test, the data collected was not normally distributed. Thus, an alternative, non-parametric test was used to compare the means, because the non-parametric test does not presume the data distribution to be normal. Further normality tests done for each question, to confirm the result in **Appendix L**, found the data was not normal ($p<0.05$).

Non-Parametric Means Test

Non- Parametric Means Test also discussed in pervious experiment in **Chapter 7.2.1.1.** Responses were collected from thirty-five participants who had experience in the game industry. The participants who played the *Cancer Game* were compared against a null value (sum of "Neither" = 3 for each question).

The participants' mean rank results were higher than the null value, which indicates that participants generally agreed or strongly agreed with the statements. In the results, the participants generally agreed with the statements related to the Social component and Engagement element. The Health and Education elements also produced a few positive results. For the game content, with the Gameplay (especially with support), Game world graphics, and Storyline statements, higher ranks were obtained compared to the null value.

The result of test statistics showed that nearly half (42%) of the results were significant ($p<0.05$), shown in **Appendix M**. In the results, most of the non-significant results were related to the Social component; seventeen questions relating to the Social component showed non-significant results. The participants had very different answers for the Social component metric questions with non-significant results. As mentioned in **Chapter 7.3**, the Social component is complex to test in gaming, as it is related both to online platforms and real communities.

Based on the statistics test results, the statements related to Engagement showed greater significance. This can be explained by Engagement being a main element in the

framework. The Health component also had positive, significant results. The Education component showed negative results. There are three possibilities for this: (i) the game gave quite general ideas about how to lead a healthy life to avoid cancer, and most people might already have known about these ideas; (ii) the greater part of the game industry is focused on the commercial aspect, which needs to attract people's attention; (iii) the content also affected the result (for example, gameplay, avatar portrayal, sound/music).

The statement regarding Avatar portrayal showed significant results. Regarding content, Gameplay (support, message and collaboration), Game world graphics and Storyline showed more significant results. The statements related to Sound/Music content showed an insignificant result.

Grouping Results

This section analyses the data when grouping the elements into six categories; Health with Education, Health with Social, Health with Engagement, Education with Social, Education with Engagement and Social with Engagement.

Normality

Normality test also discussed in **Chapter 7.2.1.1.** The Kolmogorov-Smirnov and Shapiro-Wilk tests for normality indicate insignificant results ($p>0.05$) in **Table 7.6**, indicating the data is normally distributed. Following this result, parametric tests were performed on the data, which presume the data distribution to be normal.

Table 7.6: Grouping Normality test

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	Df	Sig.
Health_with_Education	.142	35	.070	.965	35	.325
Health_with_Social	.073	35	.200*	.983	35	.850
Health_with_Engagement	.102	35	.200*	.968	35	.382
Education_with_Social	.112	35	.200*	.981	35	.799
Education_with_Engagement	.091	35	.200*	.986	35	.919
Social_with_Engagement	.077	35	.200*	.967	35	.361

*. This is a lower bound of the true significance.

Grouping Non-Parametric Means Test

Non-Parametric Means Test is also discussed in **Chapter 7.2.1.1.** A t-test was used to evaluate the extent to which the participants support the questionnaire statements. The responses from the 35 participants (N=35) for each aspect were compared against a null value. The null value was calculated from the sum of "Neither" for each of the Likert values representing a particular aspect. "Neither" on the Likert scale has the value 3. The t-test results for the metric groups are shown in **Table 7.7**, and the descriptive statistics are shown in **Table 7.8**. The metric questions with a game component, (Health, Education or Social), also affects gameplay through game contents, (Support, Messaging, Collaboration, Avatar portrayal, Game world graphics, Sound/Music and Storyline). The analysis of the *Cancer Game* highlights the social components (Health with Social, Social with Engagement) with more participants agreeing with the given statements.

Table 7.7: T-test results for metric groups

	Group	N	Mean	Std. Deviation	Std. Error Mean
Health_Education	Null	35	30.0000	<.00001	<.00001
	Participant	35	30.2286	7.08804	1.19810
Health_Social	Null	35	30.0000	<.00001	<.00001
	Participant	35	30.8571	6.37155	1.07699
Health_Engagement	Null	35	24.0000	<.00000	<.00001
	Participant	35	23.4857	5.75158	.97219
Education_Social	Null	35	30.0000	<.00000	<.00001
	Participant	35	28.9714	7.85338	1.32746
Education_Engagement	Null	35	27.0000	.00000	<.00001
	Participant	35	26.8000	6.89757	1.16590
Social_Engagement	Null	35	30.0000	<.00001	<.00001
	Participant	35	30.4857	8.07090	1.36423

Table 7.8: T-test descriptive statistics for metric groups

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Health_ Education	Equal variances assumed	43.951	<.001	-.191	68	.849	-.22857	1.19810	-2.61934	2.16220
	Equal variances not assumed			-.191	34.000	.850	-.22857	1.19810	-2.66340	2.20626
Health_ Social	Equal variances assumed	55.602	<.001	-.796	68	.429	-.85714	1.07699	-3.00624	1.29195
	Equal variances not assumed			-.796	34.000	.432	-.85714	1.07699	-3.04585	1.33156
Health_ Engagement	Equal variances assumed	52.301	<.001	.529	68	.599	.51429	.97219	-1.42570	2.45427
	Equal variances not assumed			.529	34.000	.600	.51429	.97219	-1.46145	2.49002
Education_ Social	Equal variances assumed	55.158	<.001	.775	68	.441	1.02857	1.32746	-1.62034	3.67748
	Equal variances not assumed			.775	34.000	.444	1.02857	1.32746	-1.66916	3.72630
Education_ Engagement	Equal variances assumed	52.255	<.001	.172	68	.864	.20000	1.16590	-2.12652	2.52652
	Equal variances not assumed			.172	34.000	.865	.20000	1.16590	-2.16940	2.56940
Social_ Engagement	Equal variances assumed	48.579	<.001	-.356	68	.723	-.48571	1.36423	-3.20800	2.23657
	Equal variances not assumed			-.356	34.000	.724	-.48571	1.36423	-3.25817	2.28674

Individual question results

This section analyses the six categories by comparing the means of their individual questions. In this, the individual questions are related to games content, such as

Gameplay, Avatar portrayal, Game world graphics, Sound/Music and Storyline. The statements of the game content also affect the element and components.

Health with Education

The Health with Education components had negative results with Gameplay message, Sound/Music and Storyline (**Table 7.9**). This suggests the game was not successful in helping the player understand their health issues. The Sound/Music content acts as additional support within the game; it is difficult to communicate the health message. Judging by the results, the game storyline does not help the player to understand health issues or improve their health behaviours. However, the participants did indicate they gained new knowledge from the game to improve their health, through the avatars and environment, which are related to real-life and improved the player's health behaviours. According to this outcome, the two questions in the Game world and the Sound/Music categories produced significant results.

Table 7.9: Results of Health with Education

Ranks

	Group	N	Mean Rank	Sum of Ranks
H_Education_GP_Support	Null	35	34.50	1207.50
	Participant	35	36.50	1277.50
	Total	70		
H_Education_GP_Message	Null	35	38.00	1330.00
	Participant	35	33.00	1155.00
	Total	70		
H_Education_GP_ Collaboration	Null	35	33.00	1155.00
	Participant	35	38.00	1330.00
	Total	70		
H_Education_AP	Null	35	32.00	1120.00
	Participant	35	39.00	1365.00
	Total	70		
H_Education_GW	Null	35	25.00	875.00
	Participant	35	46.00	1610.00
	Total	70		
H_Education_GW2	Null	35	32.50	1137.50
	Participant	35	38.50	1347.50
	Total	70		
H_Education_SM	Null	35	40.00	1400.00
	Participant	35	31.00	1085.00
	Total	70		
H_Education_SM2	Null	35	39.00	1365.00
	Participant	35	32.00	1120.00
	Total	70		
H_Education_SL	Null	35	36.00	1260.00

	Participant	35	35.00	1225.00
	Total	70		
H_Education_SL2	Null	35	38.50	1347.50
	Participant	35	32.50	1137.50
	Total	70		

	H_Education_ GP_Support	H_Education_ GP_Message	H_Education_ GP_ Collaboration	H_Education_ AP	H_Education_ GW
Mann-Whitney U	577.500	525.000	525.000	490.000	245.000
Wilcoxon W	1207.500	1155.000	1155.000	1120.000	875.000
Z	-.488	-1.137	-1.235	-1.728	-4.991
Asymp. Sig. (2-tailed)	.626	.255	.217	.084	<.001

	H_Education_ GW2	H_Education_ SM	H_Education_ SM2	H_Education_ SL	H_Education_ SL2
Mann-Whitney U	507.500	455.000	490.000	595.000	507.500
Wilcoxon W	1137.500	1085.000	1120.000	1225.000	1137.500
Z	-1.374	-2.288	-1.647	-.241	-1.462
Asymp. Sig. (2-tailed)	.169	.022	.099	.810	.144

Health with Social

The Mann-Whitney test for the Health with Social components showed four questions had negative results (**Table 7.10**). According to the results, the gameplay's Messaging and Collaboration do not give social or community support such as online or local platforms. Likewise, the Avatar portrayal content does not seem to lead to community support. In the significance test, the Sound/Music content of the game produced significant results. The Game world content had two questions, one of which gave a significant result and the other non-significant.

Table 7.10: Results of Health with Social

Ranks

	Group	N	Mean Rank	Sum of Ranks
H_Social_GP_Support	Null	35	25.00	875.00
	Participant	35	46.00	1610.00
	Total	70		
H_Social_GP_Support2	Null	35	24.00	840.00
	Participant	35	47.00	1645.00
	Total	70		
H_Social_GP_Messgae	Null	35	40.50	1417.50

	Participant	35	30.50	1067.50
	Total	70		
H_Social_GP_Collaboration	Null	35	37.50	1312.50
	Participant	35	33.50	1172.50
	Total	70		
H_Social_AP	Null	35	33.00	1155.00
	Participant	35	38.00	1330.00
	Total	70		
H_Social_AP2	Null	35	37.50	1312.50
	Participant	35	33.50	1172.50
	Total	70		
H_Social_GW	Null	35	35.00	1225.00
	Participant	35	36.00	1260.00
	Total	70		
H_Social_SM	Null	35	44.00	1540.00
	Participant	35	27.00	945.00
	Total	70		
H_Social_SL	Null	35	31.50	1102.50
	Participant	35	39.50	1382.50
	Total	70		
H_Social_SL2	Null	35	30.00	1050.00
	Participant	35	41.00	1435.00
	Total	70		

	H_Social_GP_ Support	H_Social_GP_ Support2	H_Social_GP_ Messgae	H_Social_GP_ Collaboration	H_Social_AP
Mann-Whitney U	245.000	210.000	437.500	542.500	525.000
Wilcoxon W	875.000	840.000	1067.500	1172.500	1155.000
Z	-4.902	-5.492	-2.379	-.953	-1.206
Asymp. Sig. (2-tailed)	.000	<.001	.017	.341	.228

	H_Social_AP2	H_Social_GW	H_Social_SM	H_Social_SL	H_Social_SL2
Mann-Whitney U	542.500	595.000	315.000	472.500	420.000
Wilcoxon W	1172.500	1225.000	945.000	1102.500	1050.000
Z	-1.034	-.231	-3.933	-1.951	-2.602
Asymp. Sig. (2-tailed)	.301	.817	<.001	.051	.009

Health with Engagement

Regarding the Health with Engagement components, there were five negative results, as shown in **Table 7.11**. The participants do not agree that the Engagement element is successful in terms of the gameplay content, such as with Support, Messaging and Collaboration. The game world does not encourage players with health issues in this game. The background music evokes a factory environment and does not provide the

kind of voice that can engage people about health. On the other hand, the participants indicated that the game could be used to link with communities in order to discuss health issues, and avatars could help bring them closer to these communities. The most important point is that the participants can focus fully on the game story whilst playing the game. Most of the game content of Gameplay that produced significant results excluded Gameplay support. The Game world and Avatar portrayal content produced the most significant results.

Table 7.11: Results of Health with Engagement

Ranks

	Group	N	Mean Rank	Sum of Ranks
H_Engagement_GP_Support	Null	35	39.00	1365.00
	Participant	35	32.00	1120.00
	Total	70		
H_Engagement_GP_ Message	Null	35	42.50	1487.50
	Participant	35	28.50	997.50
	Total	70		
H_Engagement_GP_ Collaboration	Null	35	42.00	1470.00
	Participant	35	29.00	1015.00
	Total	70		
H_Engagement_AP	Null	35	35.50	1242.50
	Participant	35	35.50	1242.50
	Total	70		
H_Engagement_AP2	Null	35	29.50	1032.50
	Participant	35	41.50	1452.50
	Total	70		
H_Engagement_GW	Null	35	26.00	910.00
	Participant	35	45.00	1575.00
	Total	70		
H_Engagement_SM	Null	35	39.50	1382.50
	Participant	35	31.50	1102.50
	Total	70		
H_Engagement_SL	Null	35	33.00	1155.00
	Participant	35	38.00	1330.00
	Total	70		

	H_Engagement_GP_Support	H_Engagement_GP_Message	H_Engagement_GP_ Collaboration	H_Engagement_AP
Mann-Whitney U	490.000	367.500	385.000	612.500
Wilcoxon W	1120.000	997.500	1015.000	1242.500
Z	-1.649	-3.334	-3.011	.000
Asymp. Sig. (2-tailed)	.099	.001	.003	1.000

	H_Engagement_AP2	H_Engagement_GW	H_Engagement_SM	H_Engagement_SL
Mann-Whitney U	402.500	280.000	472.500	525.000
Wilcoxon W	1032.500	910.000	1102.500	1155.000
Z	-2.865	-4.426	-1.870	-1.157
Asymp. Sig. (2-tailed)	.004	<.001	.061	.247

Education with Social

From the mean rank results, the Game world value ranked higher than the Null value, which means participants respond positively to the statements, as shown in **Table 7.12**. The participants had different expectations of the social component. In **Chapter 7.2**, when the games were tested with game professionals, the complexity of testing the Social component was discussed; the reason for its complexity being that it can involve both online and offline platforms. However, those participants who think that the game world represents real-life to some degree found that a game world involving more social communities informed their health issues. Statistics showed that the game content of Gameplay, including Support, Message and Collaboration, had significant results. In additional, one of the statements regarding the Game world and one regarding the Storyline both had significant results.

Table 7.12: Results of Engagement with Social

Ranks

	Group	N	Mean Rank	Sum of Ranks
E_Social_GP_Support	Null	35	37.00	1295.00
	Participant	35	34.00	1190.00
	Total	70		
E_Social_GP_Messgae	Null	35	38.50	1347.50
	Participant	35	32.50	1137.50
	Total	70		
E_Social_GP_Collaboration	Null	35	36.50	1277.50
	Participant	35	34.50	1207.50
	Total	70		
E_Social_AP	Null	35	36.50	1277.50
	Participant	35	34.50	1207.50
	Total	70		
E_Social_AP2	Null	35	37.00	1295.00
	Participant	35	34.00	1190.00
	Total	70		
E_Social_GW	Null	35	25.00	875.00
	Participant	35	46.00	1610.00
	Total	70		
E_Social_GW2	Null	35	33.50	1172.50

	Participant	35	37.50	1312.50
	Total	70		
E_Social_SM	Null	35	42.00	1470.00
	Participant	35	29.00	1015.00
	Total	70		
E_Social_SM2	Null	35	40.50	1417.50
	Participant	35	30.50	1067.50
	Total	70		
E_Social_SL	Null	35	37.00	1295.00
	Participant	35	34.00	1190.00
	Total	70		

	E_Social_GP_ Support	E_Social_GP_ Messgae	E_Social_GP_ Collaboration	E_Social_AP	E_Social_AP2
Mann-Whitney U	560.000	507.500	577.500	577.500	560.000
Wilcoxon W	1190.000	1137.500	1207.500	1207.500	1190.000
Z	-.707	-1.375	-.476	-.517	-.707
Asymp. Sig. (2-tailed)	.480	.169	.634	.605	.480

	E_Social_GW	E_Social_GW2	E_Social_SM	E_Social_SM2	E_Social_SL
Mann-Whitney U	245.000	542.500	385.000	437.500	560.000
Wilcoxon W	875.000	1172.500	1015.000	1067.500	1190.000
Z	-4.982	-.975	-3.137	-2.379	-.706
Asymp. Sig. (2-tailed)	<.001	.330	.002	.017	.480

Education with Engagement

The mean ranks test had positive results in the Education with Engagement element, shown in **Table 7.13**. In the results, gameplay Support and Messaging showed higher ranks than the null value. The participants found the game illustrated the health-related messages and made them possible to discuss with other people. Avatar portrayal and Game world also had higher ranks; this suggests the avatar and game world motivated the player to discuss health issues by showing real-life health issues. Based on the statistics result, the Support, Messaging and Collaboration questions had significant results. One of the statements relating to Game world and one relating to Storyline also had significant results.

Table 7.13: Result of Education with Engagement

Ranks

	Group	N	Mean Rank	Sum of Ranks
E_Engagement_GP_Support	Null	35	31.00	1085.00
	Participant	35	40.00	1400.00
	Total	70		
E_Engagement_GP_ Messgae	Null	35	30.00	1050.00
	Participant	35	41.00	1435.00
	Total	70		
E_Engagement_GP_ Collaboration	Null	35	40.50	1417.50
	Participant	35	30.50	1067.50
	Total	70		
E_Engagement_AP	Null	35	35.50	1242.50
	Participant	35	35.50	1242.50
	Total	70		
E_Engagement_GW	Null	35	33.50	1172.50
	Participant	35	37.50	1312.50
	Total	70		
E_Engagement_GW2	Null	35	28.50	997.50
	Participant	35	42.50	1487.50
	Total	70		
E_Engagement_SM	Null	35	37.50	1312.50
	Participant	35	33.50	1172.50
	Total	70		
E_Engagement_SL	Null	35	37.50	1312.50
	Participant	35	33.50	1172.50
	Total	70		
E_Engagement_SL2	Null	35	43.00	1505.00
	Participant	35	28.00	980.00
	Total	70		

	E_Engagement _GP_Support	E_Engagement _GP_Messgae	E_Engagement _GP_ Collaboration	E_Engagement _AP	E_Engagement _GW
Mann-Whitney U	455.000	420.000	437.500	612.500	542.500
Wilcoxon W	1085.000	1050.000	1067.500	1242.500	1172.500
Z	-2.129	-2.658	-2.338	.000	-.975
Asymp. Sig. (2-tailed)	.033	.008	.019	1.000	.330

	E_Engagement GW2	E_Engagement SM	E_Engagement SL	E_Engagement SL2
Mann-Whitney U	367.500	542.500	542.500	350.000
Wilcoxon W	997.500	1172.500	1172.500	980.000
Z	-3.339	-1.033	-.974	-3.617
Asymp. Sig. (2-tailed)	.001	.302	.330	<.001

Social with Engagement

The Social with Engagement group showed positive mean rank results, as shown in **Table 7.14**. From the mean rank result, Avatar portrayal, Game world and Sound/Music had lower ranks than the null value. The participants indicated that the social component is very important; the game can raise social awareness. The game message helps people become involved in communities by including a social media platform to encourage players to become closer to each other. The storyline helps participants discuss their interests, increasing the size of the communities. Gameplay Support and Messaging both produced significant results. Avatar portrayal also had a significant result in the statistics.

Table 7.14: Results of Social with Engagement

Ranks

	Group	N	Mean Rank	Sum of Ranks
S_Engagement_GP_ Support	Null	35	29.00	1015.00
	Participant	35	42.00	1470.00
	Total	70		
S_Engagement_GP_ Support2	Null	35	31.00	1085.00
	Participant	35	40.00	1400.00
	Total	70		
S_Engagement_GP_ Support3	Null	35	33.50	1172.50
	Participant	35	37.50	1312.50
	Total	70		
S_Engagement_GP_ Message	Null	35	29.50	1032.50
	Participant	35	41.50	1452.50
	Total	70		
S_Engagement_GP_ Collaboration	Null	35	35.00	1225.00
	Participant	35	36.00	1260.00
	Total	70		
S_Engagement_AP	Null	35	40.50	1417.50
	Participant	35	30.50	1067.50
	Total	70		
S_Engagement_GW	Null	35	36.50	1277.50
	Participant	35	34.50	1207.50
	Total	70		
S_Engagement_SM	Null	35	39.50	1382.50
	Participant	35	31.50	1102.50
	Total	70		
S_Engagement_SL1	Null	35	33.50	1172.50
	Participant	35	37.50	1312.50
	Total	70		
S_Engagement_SL2	Null	35	32.50	1137.50
	Participant	35	38.50	1347.50
	Total	70		

	S_Engagement_GP_Support	S_Engagement_GP_Support2	S_Engagement_GP_Support3	S_Engagement_GP_Message	S_Engagement_GP_Collaboration
Mann-Whitney U	385.000	455.000	542.500	402.500	595.000
Wilcoxon W	1015.000	1085.000	1172.500	1032.500	1225.000
Z	-3.090	-2.172	-1.002	-2.813	-.247
Asymp. Sig. (2-tailed)	.002	.030	.316	.005	.805

	S_Engagement_AP	S_Engagement_GW	S_Engagement_SM	S_Engagement_SL1	S_Engagement_SL2
Mann-Whitney U	437.500	577.500	472.500	542.500	507.500
Wilcoxon W	1067.500	1207.500	1102.500	1172.500	1137.500
Z	-2.439	-.500	-2.003	-.952	-1.502
Asymp. Sig. (2-tailed)	.015	.617	.045	.341	.133

7.2.3.2 Questionnaire Internal Consistency

The purpose of this test was to evaluate the internal consistency of the fifty-seven Likert-scale questions. The value of the Cronbach's alpha test was $\alpha = 0.967$ (**Table 7.15**), which indicates a high level of internal consistency for the collected sample in these questions. It also means that the response data gathered is reliable.

Table 7.15: Cronbach's Alpha Output

Reliability Statistics

Components	Cronbach's Alpha	N of Items
All Questions	.967	57

The Cronbach's alpha value was also calculated for each component and element, shown in **Table 7.16**. While some questions had lower values then overall result ($\alpha = 0.967$), they differed only by 0.001, which is an insignificant gap.

Table 7.16: Questions Cronbach's Alpha

Element	Questions	Cronbach's Alpha if Item Deleted
Health - Education	H_Education_GP_Support	.966
	H_Education_GP_Message	.967
	H_Education_GP_Collaboration	.967
	H_Education_AP	.967

	H_Education_GW	.968
	H_Education_GW2	.967
	H_Education_SM	.967
	H_Education_SM2	.968
	H_Education_SL	.966
	H_Education_SL2	.966
Health - Social	H_Social_GP_Support	.967
	H_Social_GP_Support2	.967
	H_Social_GP_Messgae	.966
	H_Social_GP_Collaboration	.966
	H_Social_AP	.967
	H_Social_AP2	.968
	H_Social_GW	.967
	H_Social_SM	.967
	H_Social_SL	.966
	H_Social_SL2	.967
Health - Engagement	H_Engagement_GP_Support	.967
	H_Engagement_GP_Message	.967
	H_Engagement_GP_Collaboration	.967
	H_Engagement_AP	.966
	H_Engagement_AP2	.966
	H_Engagement_GW	.967
	H_Engagement_SM	.967
	H_Engagement_SL	.966
Education - Social	E_Social_GP_Support	.966
	E_Social_GP_Messgae	.967
	E_Social_GP_Collaboration	.967
	E_Social_AP	.966
	E_Social_AP2	.966
	E_Social_GW	.967
	E_Social_GW2	.966
	E_Social_SM	.967
	E_Social_SM2	.967
	E_Social_SL	.966
Education - Engagement	E_Engagement_GP_Support	.966
	E_Engagement_GP_Messgae	.967
	E_Engagement_GP_Collaboration	.966
	E_Engagement_AP	.966
	E_Engagement_GW	.966
	E_Engagement_GW2	.967
	E_Engagement_SM	.966
	E_Engagement_SL	.966
	E_Engagement_SL2	.967
Social - Engagement	S_Engagement_GP_Support	.967

	S_Engagement_GP_Support2	.967
	S_Engagement_GP_Support3	.966
	S_Engagement_GP_Message	.966
	S_Engagement_GP_Collaboration	.966
	S_Engagement_AP	.966
	S_Engagement_GW	.966
	S_Engagement_SM	.967
	S_Engagement_SL1	.966
	S_Engagement_SL2	.966

7.2.4 Discussion

The *Cancer Game* was tested focusing on the three components (Health, Education and Social), one element (Engagement) and five aspects of game content (Gameplay, Avatar portrayal, Game world, Sound/Music and Storyline), which were connected to each other. According to the results, Engagement as a metric goal showed a significant, positive result. The majority of statements relating to the Health component showed significant results, with half the statements in the metric questions agreed by participants. The results for Education were negative, possibly because of the chosen game giving only very basic ideas about cancer; participants were thus unable gain new knowledge from the game. Although the Social component is difficult to test, the mean ranks results showed participants agreed with 50% of the statements.

7.3 Chapter Summary

This Chapter divides into two main sections including piloting and exploratory experiments. Piloting uncovered potential flaws before the experiment too place; Examining why discusses the game were chosen **(Chapter 7.1.2)**, timing **(Chapter 7.1.3)**, and questionnaire suitability **(Chapter 7.1.4).** The purpose of exploratory experiment I was to measure the reliability of the metric instrument with six different games and to acquire the feedback of professionals on each of the elements; Exploratory experiments II collected a larger sample in order to measure reliability of the metric which is also discussed in **Chapter 6.2.3** and **Chapter 7.2.3.**

According to the result from Exploratory experiments, GQM metric table are reliable. Exploratory experiments I and II were tested with five experienced game professionals

with six games, and game professionals with the *Cancer Game*, respectively. The finding of exploratory experiments I are discussed in **Chapter 7.2.2** and exploratory experiments II are discussed in **Chapter 7.2.4**. From the results, the Social component was complex to measure and Engagement was the main element to interact people's attention and encourage players involved in social communities for the purpose of health and education (Heward, et al., 2017). The fact that these games were small scale, had a limited budget and preproduction, compared to some of the games in the games analysis, is a limiting factor. However, at this stage the focus is on the game content. The social component is important, but the preproduction aspect of the games may account for the unsuccessful results of the social component aspects of the games (Ciebel, et al., 2016).

In the next chapter, the design and development of a mock-up game for supporting dementia family carers at pre- and early-stages is discussed (Enshaeifar S, et al., 2018). There are no similar games that currently exist for dementia family carers. The mock-up game design includes the framework elements and refinements from Exploratory experiments I and II. The mock-up game was tested with dementia family carers using the refined instrument, and by interviews with dementia family carers with open end questions.

Chapter 8. Game design for dementia family carers

The discussion in this chapter concerns game design, specifically for the game **Make a cup of tea**. Game design for different purposes is discussed in general terms, then the development of **Make a cup of tea** is discussed, which is designed for dementia family carers dealing with patients with pre- and early-stage dementia.

8.1 Make a Cup of tea

The game was designed according to the framework, which also includes refinements from exploratory experiments I and II in **Chapter 7.2.** This section discusses a mock-up game for dementia carers, including the game system, game content and game purpose.

8.1.1 Game for dementia family carers

The game was designed for dementia carers at pre- and early-stages. In **Make a cup of tea**, in it, five mini-games are played in order to complete the task of making a cup of tea, which some dementia patients are unable to do.

The five mini-games help to illustrate the five key messages about dementia, explained on the website from the organization *Dementia Friends*:

1. Dementia is caused by diseases of the brain
2. Dementia is not just about losing your memory; it can affect thinking, communicating and doing everyday tasks
3. It is possible to live well with dementia
4. Dementia is not a natural part of ageing
5. There is more to a person than the dementia

In these five stages, players will need to win five key tools for making a cup of tea, such as a cup, hot water, tea bag, sugar and milk. Each stage will have its own game story with a message, and also give information as a suggestion for people caring for dementia patients (**Table 8.1**). Based on the framework, games for change are designed to support the Education, Health and Social issues with different platforms. Therefore, the proposed game is based on these issues from the framework. In the proposed game,

the Education component increases the player's knowledge of dementia and provides suggestions about caring for people with dementia. By playing the **Make a cup of tea** game (**Figure 8.1**), dementia family carers will develop a better understanding of dementia, reduce their negative emotions and from this they will build up a positive relationship.

Table 8.1: Games Details

Step	Tools	Message	Game Type	Game Story	Information
Game 1	Cup	The people with dementia have their own personalities too	**Choose the avatar on the cup** 1. Choose the cup's colour 2. Choose the cup's emotion 3. Choose a picture of your interest	Different designs on the cups illustrate how different people have different personalities.	Let the people with dementia retain their identity e.g. let them choose what clothes they like to wear.
Game 2	Hot water	Dementia is not a natural part of ageing	**Move person to catch drops** When the player misses a drop the age in the game goes up and the character becomes slower. The number of drops caught will be the score. When the player reaches 100 the input keys start to swap around, i.e. when the left key is pressed sometimes it goes to the right and vice versa for a period. A confused icon is shown when this happens.	Normal aging process is shown through slower movements.	Slowing down is a natural part of the aging process. However, those with dementia can additionally lose concentration more easily, making everyday tasks more difficult.
Game 3	Tea bag	Dementia is caused by brain diseases	**Brain training game** The player needs to find the matching tea bag under the cards, just like the card game Pairs. Alcoholic drinks, which are bad can cause more cards to appear. Good cards make the number cards to decrease.	People with dementia can find it difficult to remember things. Drinking non-alcoholic drinks and having a healthy lifestyle can reduce the risk of getting dementia	One common disease, which causes dementia is the Alzheimer's disease. People who adopt a healthy lifestyle, especially from mid-life onwards, are less likely to develop Alzheimer's disease. This means that carrying out healthy lifestyles such as regular physical exercises, maintaining a healthy weight, not

					smoking, having a balanced diet and moderate drinking
Game 4	Sugar	Dementia is not just about memory lost, it can affect thinking, communicating and doing everyday tasks	**Message game** The player has to find that item shown at the bottom of the screen in a scattered collection of things on the screen. The score corresponds to the number of items found in the given time.	People with dementia find it hard to understand communication. People taste with dementia changes they often like sweet things.	Dementia people may find it difficult to communicate or convey their thinking. Carers need to be more patient to understand their needs.
Game 5	Milk	It is possible to live well with dementia	**Historical game** The player has to answer multiple choice questions on historical events. When the player answers the questions correctly he/ she will be awarded with some milk in a container. The player needs to obtain just the right amount of milk to top up their tea. The historical questions on well-known events include: • The Hundred Years War was fought between what two countries? • In 1594, William Shakespeare joined the company of which London theatre? • In which year did World War 1 begin?	People like to talk about the past.	General non-drug approach often helps to reduce the symptoms of dementia. This includes social interaction, music, reminiscence, exercise or other activities that are meaningful for the person. This approach is often being used before additional drugs are considered, particularly antipsychotics.

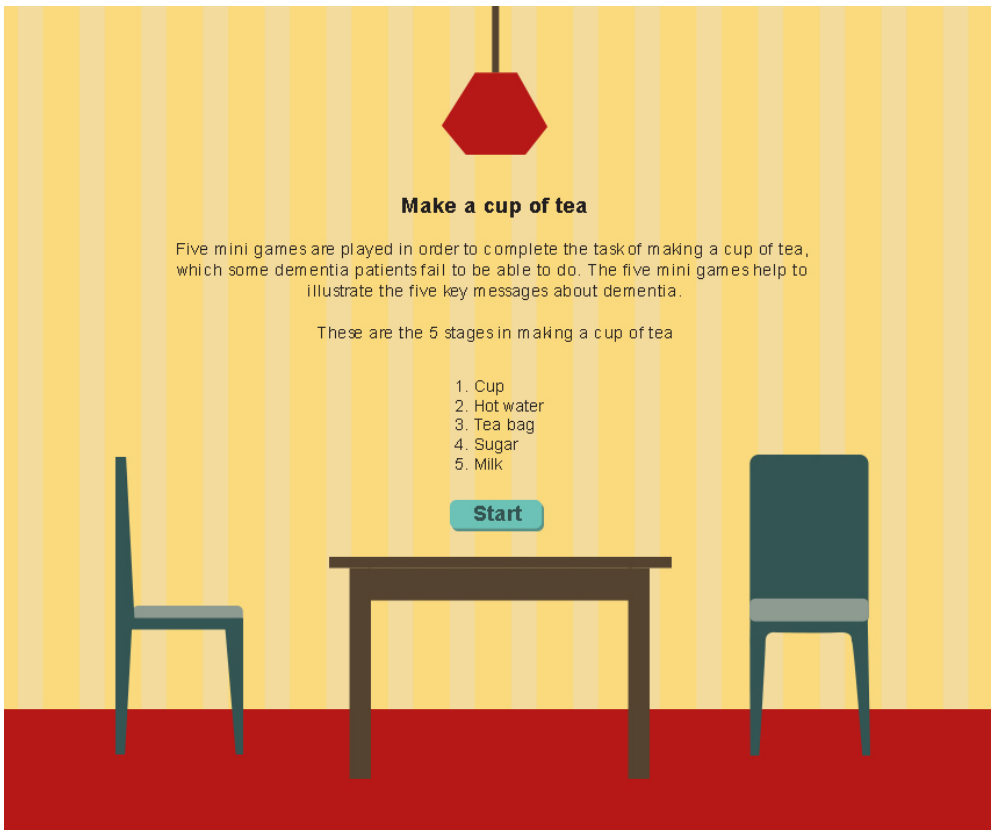

Figure 8.1: Make a cup of tea

8.1.2 Game System

The game system is focused on two areas; platform and genre. As online technologies would be able to spread the message quickly, choosing an online platform that is able to link with actual communities would achieve more meaning for the game. From the games analyses in **Chapter 6.1**, there are a few genres usable for this study, which include:

- Adventure: use an adventure game to explore the real problems and solve them. Therefore, it will help dementia carers face their real-life problems.
- Simulation: Building up the actual world for players. It can depict actual situations to help people understand dementia.

The **Make a cup of tea** game will try to create a message within for the player, while also trying to give the information about what the best solutions are to deal with particular problems.

8.1.3 Game Content

The game content was designed according to the metrics results from the Exploratory experiments in **Chapter 7.2** and discussed in **Chapter 4.2.2**. In accordance with the study being focused on visual design for the mock-up, Sound/Music was removed. The game content is described below:

Gameplay

The game includes five mini-games, each of which delivering one of the five keys messages about dementia, and suggestions about how to support dementia patients (Gee, 2016).

Support:

- Game support educating the player and increasing their knowledge of health issues
- Game act as a platform to engage players and improve their health
- Game supports multiple ways to solve the problems

Message:

- Game's message information conveys the health component
- Game gives the message/information to encourage people to discuss the issues

Collaboration:

- Game links up with the Education component to give health knowledge for dementia care
- Game engages people to improve their health
- Gameplay engages people in terms of the knowledge

Avatar Portrayal

In the beginning of the game, the player can choose their own avatar by choosing colours, emotions and interests. For example, in the first mini-game, the message is: "*There's more to a person than the dementia*", which encourages carers to let their patients retain their identity (**Table 8.1**).

- Game gives the message for changing health behaviour through avatar characteristics

Figure 8.2: Choose your own avatar

Game-world Graphics

The game world is portrayed as a home, to try to give player the feeling of being at home, to help the player become involved quickly. It uses a simple design and icons to guide the player.

- Game environment reflects situations in the real world
- Game world engages people with health behaviour
- Game world provides useful knowledge that links with real world

Storyline

The main story gives ideas of what dementia sufferers face in their daily lives. Each mini-game shows different issues of dementia (for example, emotion, memory and communication) (Cutler,2016).

- Game story helps the player change their health behaviour

- Game story keeps the player invested in the game
- Game story can engage the player to improve their health
- Game story makes it more entertaining, to keep the player invested

8.1.4 Game Purpose

The research purpose is to investigate how to support dementia carers through games. The purpose of designing the games was deliver knowledge of health issues in order to give an understanding of dementia and suggestions for supporting dementia patients as family carers. Games were designed according to the framework with three components: health, education and social, see **Chapter 6.1.1**. Exploratory experiments show that the metric instrument was measured to check if these components were reliable for the dementia family carers. Currently, there are no related games that focus on the dementia family carer. The mock-up game was created to evaluate the games components from the framework to support dementia family carers.

Make a cup of tea is a game for three purposes: Health, Education and Social.

- Game for Health: a platform for the transfer of knowledge about dementia and suggestions for family carers to improve their health behaviour, such as managing their negative emotions.
- Game for Education: in the game, player increases their knowledge about dementia, and are provided suggestions about caring for people with dementia though the game story and information.
- Social Game: the social component is realised through raising awareness of dementia and allowing the player to discuss these issues. In this study, it is achieved by fully supporting dementia carers' need to link with both an online social network and the local community to help engage people and discuss their problems, while also helping each other.

8.2 Chapter Summary

The designed game, **Make a cup of tea**, consists of a game story relating to dementia in order to engage dementia family members to play. In the game, different skills and challenge levels correspond to the dementia symptoms. Players might struggle with

some levels of the game. However, the game is intended to give the player an experience of how it might feel for a dementia patient as they struggle with day to day life. The goal of the game is for dementia families to understand how to care for dementia patients and bring people together to discuss this issue.

The purpose of **Make cup of tea** is to support dementia family carers at pre- and early-stages. Based on the results of exploratory experiments Ⅰ and Ⅱ, the design is focused primarily on the Education and Health components. The game system is designed to tell a story about dementia symptoms, and provide suggestions for family carers about caring for dementia patients. A concept document was produced, containing the five key messages of dementia. The game design, such as game-world graphics and avatar portrayal, are designed as simple icons and easy to play for general players. In addition, the game's story was made as easy as possible to understand.

Make a cup of tea was designed as a mock up game to test and interview with dementia family carers; it is the concept of the game. There are various details which needed to improve. In this research stage, the game is main platform. It could be further involved with social platforms with online and local communities to fully achieve supporting dementia family carer with the Education, Health and Social components.

Chapter 9. Experiment I and II

In the previous chapter, the design and development of a game for dementia family carers at pre- and early-stages. The following experiments involved testing this game with dementia family carers with two stages; the first is experiment I, which involved testing the game with dementia family carer using the created metric instrument; the second is experiment II, which involved interviews with dementia family carers.

9.1 Experiment I: Testing mock-up game with dementia family carers

This stage involved testing the mock-up game with dementia family carers using the metric instrument. The mock-up game is described in **Chapter 8.** In this chapter, we discuss the results of comparing the means of individual framework elements and grouped combinations. The respondents included twenty participants, four male and sixteen female, shown in **Table 9.1**. Most of the participants' ages were in the 65-75 range, with six participants, as also shown in **Figure 9.1.** The demographics of the participants of experiment I correspond to the literature review in **Chapter 2.5**, discussing dementia carers' needs. Most family carers are women and 34% are aged 65 or over.

Table 9.1: Respondent's gender of participants

Gender	Male	Female
Number of Participants	4	16

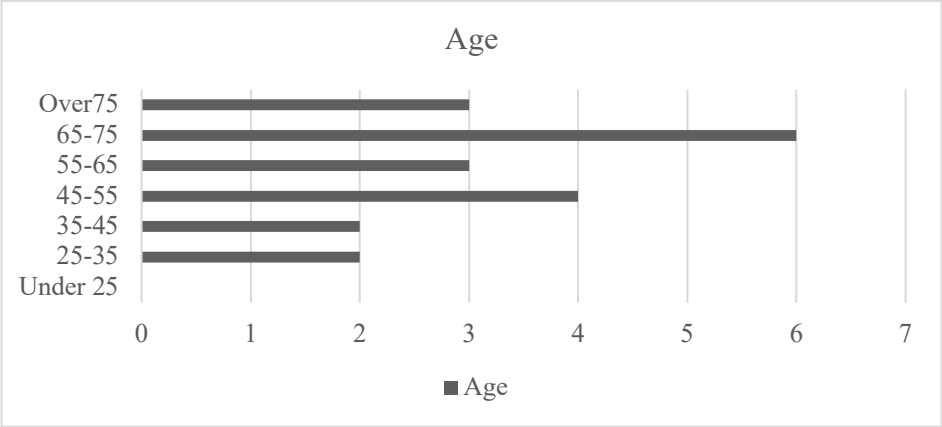

Figure 9.1: Respondent's age ranges

9.1.1 Normality

The Kolmogorov-Smirnov and Shapiro-Wilk tests of normality were performed on the data, as shown in **Appendix N.** The normality test had insignificant results ($p < 0.05$), meaning the data distributions were normal, therefore performing a t-test would be appropriate (Field, 2009, p.343).

9.1.2 Independent-Samples T-test

Responses were collected from twenty participants who were dementia family carers. The participants who played the **Make a cup of tea** were compared against a null value (sum of "Neither" = 3 for each question). The participants' mean results were higher than the null value, which indicates that participants generally agreed or strongly agreed with the statements. There were lower results, including H_Education_SM and E_Social_SM (**Appendix O**); these questions are:

- The game's background music / sound got in the way of understanding the health issues.
- I think the background music and sound helped improve my knowledge of the health issues.

Make a cup of tea focuses on the visual design mentioned in the game content in **Chapter 8.1.3.** The unsuccessful results recorded in the independent sample t-test were highly associated with the background music of the game. It is concluded that the sound and music does not have a huge impact on the overall gaming experience, as it is a supplement instead of the core element of the game. Nevertheless, the issue will be addressed for future improvement.

9.1.3 Grouped Results

For these tests, the framework elements were grouping the six factors; Health with Education, Health with Social, Health with Engagement, Education with Social, Education with Engagement and Social with Engagement. The following tests, including normality and means test to measure the ability of **Make a cup of tea** to support dementia family carers, especially at pre- and early-stages.

9.1.3.1 Normality

The group factors results for the Kolmogorov-Smirnov and Shapiro-Wilk normality tests indicated a significant result for Health and Social ($p < 0.05$), shown in **Table 9.2**; thus, non-parametric tests were used to analyse the data, as they do not presume the data distribution to be normal.

Table 9.2: Grouping Normality test

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Health_Education	.140	20	.200*	.971	20	.779
Health_Social	.226	20	.009	.916	20	.084
Health_Engagement	.120	20	.200*	.960	20	.539
Education_Social	.170	20	.134	.931	20	.159
Education_Engagement	.154	20	.200*	.982	20	.955
Social_Engagement	.145	20	.200*	.944	20	.291

*. This is a lower bound of the true significance.
Lilliefors Significance Correction

9.1.3.2 Grouping Non-Parametric Means Test

The Mann-Whitney test on the grouped factors had higher mean ranks than the null value (answering every question with No Opinion = 3), as shown in **Table 9.3**, which indicates that participants generally agreed or strongly agreed with the statements. Each of the factors had significant results ($p<0.05$), as shown in **Table 9.4**.

Table 9.3: Grouping the Mann-Whitney Mean Rank

Ranks

	Group	N	Mean Rank	Sum of Ranks
Health_Education	Null	20	13.50	270.00
	Participant	20	27.50	550.00
	Total	40		
Health_Social	Null	20	13.00	260.00
	Participant	20	28.00	560.00
	Total	40		
Health_Engagement	Null	20	13.50	270.00
	Participant	20	27.50	550.00
	Total	40		
Education_Social	Null	20	12.50	250.00
	Participant	20	28.50	570.00
	Total	40		
Education_Engagement	Null	20	12.00	240.00
	Participant	20	29.00	580.00
	Total	40		
Social_Engagement	Null	20	11.50	230.00
	Participant	20	29.50	590.00
	Total	40		

Table 9.4: Grouping the Mann-Whitney Significance Statistics

Test Statistics[a]

	Health_ Education	Health_ Social	Health_ Engagement	Education_ Social	Education_ Engagement	Social_ Engagement
Mann-Whitney U	60.000	50.000	60.000	40.000	30.000	20.000
Wilcoxon W	270.000	260.000	270.000	250.000	240.000	230.000
Z	-4.152	-4.397	-4.150	-4.746	-4.974	-5.337
Asymp. Sig. (2-tailed)	.000	.000	.000	.000	.000	.000
Exact Sig. [2*(1-tailed Sig.)]	<.001[b]	<.001[b]	<.001[b]	<.001[b]	<.001[b]	<.001[b]

a. Grouping Variable: Group
b. Not corrected for ties.

9.1.4 Discussion

The mock-up game, **Make a cup of tea** was being tested with dementia family carers in experiment I to test the Health, Education and Social components of the game. Among the three components, the Social component was the most difficult to be quantified as it was highly complex and involved a broad range of aspects. In spite of that, **Make a cup of tea** showed positive results in all 3 components in experiment I, which suggests that the platform of the game is able to support dementia families in pre- and early-stages. However, **Make a cup of tea** is still far from being a complete game improvements have to be made on the quality of the game content, such as the gameplay, avatar, game world graphics, sound/music and the storyline. Specifically, the sound/music serves as an additional support element to the gaming experience and was not the primary focus of the research. In the following experiment II, interviews were conducted with dementia family carers to obtain more data in order to improve the mock-up game.

9.2 Experiment II：Interviews with dementia family carers

The purpose of these interviews with dementia family carers with the mock-up games was to directly acquire in depth feedback on the mock-up games, as well as to gathering suggestions for future development of work to support family carers at pre- and early-stages.

9.2.1 Interview Analysis

The interviews were conducted with dementia family carers in Hampshire with twelve participants, involving ten families, shown in **Table 9.5**. The aim was to identify which games could give the most support to local family carers dealing with pre- or early-stage dementia. According to the methodology review in **Chapter 4.1.1.2**, most potential software usability problems can be identified with ten participants (Rogers, et al., 2011).

Table 9.5: Number of participants per family

ID	Number of Participants
F1	2
F2	1
F3	1
F4	1
F5	1
F6	1
F7	1
F8	1
F9	1
F10	2
Total	**12**

9.2.1.1 Mock-up game supporting dementia family carer

The purpose of the mock-up game was to support dementia family carers dealing with pre- or early-stage dementia. The following section provides the analysis of the interviews with dementia family carers in general, of the game for dementia and dementia carers, of the game's engagement of dementia family carers, feedback on the game design, the social community in the game, the five mini-games, advice and future development.

9.2.1.2 Make a cup of tea, in general

The overall thoughts on the mock-up game **Make a cup of tea** registered positive feedback from the interview participants. Respondent **F1** pointed out that there is no

great resource to support dementia patients and dementia family carers which can describe the true situation of dementia and of being a carer. In addition, **F1** and **F9** mention that the mock-up game is useful for pre- or early stage dementia family carers, in order to assist their understanding of dementia.

F1: *Excellent idea and a great resource for dementia patients which isn't available at the moment. This comes from personal experience of a family member with dementia. Using everyday items and experience is relevant and would not insult her as she is treated like an equal to others……..Best for those who have just started caring or early stage dementia.*

F9: *It came a bit out of the blue. And it is not about memory, it's about understanding other things. Which are quite subtle for people who haven't known somebody who has dementia. So this game is useful for showing things like that. It is not just about memory.*

The mock-up game represents the actual situation of dementia and provides information for family carers, in the opinions of **F4**, **F5** and **F9**.

F4*: I like the idea of using a game to show family the problems faced by the sufferer…This will be a valuable learning aid that will help with the incredible frustration.*

F5: *I got quite a lot of information. It looks quite good. The idea is very good.*

F9: *I thought it was a good game because it takes account of the different types of how dementia will affect people's abilities.*

Dementia falls roughly into three stages: early, middle and late. There are various types of dementia with different symptoms, as discussed in **Chapter 2.5**. The stage and type of dementia affects the person's cognitive dissonance to different degrees.

9.2.1.3 Game for dementia patients and dementia carers

Make a cup of tea is a game focused on the dementia family carer dealing with pre- or early- stage dementia. Based on the opinions of **F3**, **F7** and **F8**, the mock-up game can work for the dementia patients themselves in order to assist understanding of themselves and as a daily activity, especially as described by **F7**, who found that the game can help the dementia patient himself to move on.

F3: *My mum for example, almost certainly had a go and the memories that one. I mean not that she is into computers at all, but how she's been, that is one she could have gone for.*

F7: *... told us he got dementia he denied it, he was in denial a very, very long time. Have contact to doing thing like this thing it would be very good. This game will help him to move forward. It would be good for him to do something constructive.*

F8: *I think it is very simple, so somebody with dementia will be able to follow the game without getting stressed out.*

Respondent **F6** mentions that the game can be a great platform to get together and understand the situation which can improve the relationship between dementia patients and family carers.

F6: *To get the family to work together to understand the situation it is a great thing.*

9.2.2 Game engagement for dementia family carers

The game is an entertainment platform to capture people's attention. According to the interviews, **F6** and **F10** found **Make a cup of tea** to be an entertainment platform to support dementia families in order to understand the dementia issues.

F6: *I think anything that helps the families understand and be able to interact with that person is very important.*

F10: *I thought the games were entertaining and the first three got the message across very well.*

9.2.2.1 Game design feedback

The mock-up game focused on the concept of understanding whether the games are reliable in supporting dementia family carers. However, the following discussion of game design also arose. **Make a cup of tea** was developed with easy and simple levels to play for general users. In compliance with **F3**, **F4** and **F7**'s feedback, the games are simple and easy to play even for people who have dementia. However, from **F4** and **F8**'s points of view, the descriptions of their use are important as they also give more detail regarding understanding the effect on the brain in helping the player to increase their knowledge.

F3*: I like the colours, simple, easy to do. I can see the point of trying to work out what people can do. Work out left and right, how quickly they actually react.*

F4: *Very clear and easy to play. Needs good descriptions of what will happen and the purpose.*

F7: *I like you got nice colour there. The colour you can choose. Looks very easy to do it, easy to follow. At the stage my husband is I don't think he will have that much problem following it.*

F8: *Maybe give more understanding of how the brain is effective because people don't understand do they. How the brain, in dementia, how part of the brain is lost. You can't reason or think through things.*

9.2.2.2 Social community in game

In this stage, the game is the main platform to test with dementia family carers, whereas social components can constitute additional support, as supported by **F1** and **F3**.

F1: *Linking to a dementia group and community would be great. The opportunity for carers and individuals with dementia to have an online platform to share experiences would be ideal.*

F3: *One of these situations is the more information you got, the better. The question is people know where to go for help, and publicising that as widely as you can. Social media is great there but does not target patients generally, but children can share it with them.*

Children as a dementia family members using the social media platform together with the dementia patient can improve the relationship between the dementia patient and the family member.

9.2.2.3 Five mini games advice

The **Make a cup of tea** game contained the five mini-games, each representing different symptoms a dementia patient might have and advice for dementia family carers. In this section, each game is discussed in turn.

<u>Game 1</u>

According to the **F2**'s interview feedback, the game avatar can express the player's emotion but from a personal point of view, the emotion does not need to show on the

cup. In Game 1, the *going to sent them into overdrive even shut them down; is always better to give. But you still give choice. So you give people the opportunity to make decisions on their life's jobs. You know, what you wearing today.*

Game 2

In the interview with dementia carers, **F7** refers to Game 2 in which the player needs to catch drops representing the normal aging process; during the game, players also count the drops, as in a brain training game with easy maths.

F7: *You know that is what you need to keep him alive if you like, because it can be a life but it is uncomfortable. It's a very fine line where is shapes you got, you know, counting is why you got drops that need to go into the jar. That is a very good idea because it teaches us to keep counting and using their grey matter if you like to do it.*

Game 3

Game 3 was a brain training game, which has pairs of cards representing tea, water and alcohol. Alcoholic drinks are bad and make more cards appear. According to respondent **F1**, players might have been confused as they can pair up the alcoholic cards. However, the aim is to make players notice that alcohol has a negative effect on dementia patients.

F1: *Game 3 - is good but confusing, maybe need to make it clearer to pick a healthy thing.*

Game 4

In this game, which is a message game, the player gets an item shown at the bottom of the screen. The player then has to find that item amongst a collection of things on the screen. This game is easy to play and represents the dementia patients' symptoms, but they might be confused about the message they have been given. Respondent **F7** noticed the game could also be played by dementia patients themselves.

F7: *very good for them to recognise shapes and their ability to do things.*

Game 5

Make a cup of tea focused on English culture with basic history. However, from the feedback of respondents **F8** and **F9**, the historical game involved the player's background culture and personal interests.

F8: *I think the last bit of this one, the culture and questions. That might be difficult for some people, because they go to read it and understand it… I think it might be difficult to get people to read the questions, they maybe will not have understanding of what the question is.*

F9: *I am unsure about the later question about history knowledge because people might not know some of these facts…… Some people have got a knowledge of history, some music, fashion. I think you got to be careful of not asking people you disrespect them to know or some of the questions are fairly basic, they should know these. Keep them fairly basic I said.*

9.2.2.4 Further development

Make a cup of tea is a game in the first stage to support dementia family carers and to raise awareness of dementia and increase players' knowledge of health issues. There were suggestions from interviewees **F1** and **F2** for further achievement, such as expanding the game with various items according to personal interests, such as painting, gardening and so on. In addition, **F2** made the suggestion of using the game as a tool to measure and record dementia patients' mental and physical abilities, and also could be a platform with medical information to give dementia patients and carers choice in their medical journey.

F1: *Ideas to promote this further could be decorating the home, simple gardening tasks, making a cake.*

F2: *If they had a tool which actually recorded over the period of time how someone's feeling, then actually they would… as you actually do the simple tasks. If you had the facility to remember how someone was today / in six months' time / in a year's time it would actually show, a decline in a person's ability.*

F2: *The platform to give information about dementia and to give dementia carers choice to help them in their medical journey. They could have just been told they have dementia. They have no knowledge, no experience at all. They do not know. This is a sad thing in society at the moment. You have bad press about it.*

9.2.3 Discussion

In accordance with the interviewees, **Make a cup of tea** is a game platform that can increase a player's knowledge of health issues by understanding dementia and can give

advice on caring with dementia. Playing the game can also increase positive relationships between dementia patients and dementia carers. For example, through the game, dementia patients can face their own problems and family carers are able to understand them better. Social components in the game are mentioned in **Chapter 8**; it is complex to measure them in the game the degree to which social communities are involved with online platforms and local communities. However, interview feedback on the game reveals that it is an entertainment platform that can attract people, engage people to discuss issues of dementia and can help them to find support. Judging by the interviewees' feedback, the game could be developed with various purposes in mind, including expanding to encompass different personal interests and involving mental and physical ability, or recording their medical journey. In addition, it could provide the medical information needed to give the dementia patients and carers the knowledge to make decisions about their treatment.

9.3 Chapter Discussion

In this chapter, experiment I and experiment II were carried out with the participation of the dementia family carers using different approaches, such as instrument measurement and interviews.

The three components of the game based on the framework, namely Health, Education and Social, were the main focus of the investigation. In particular, the Social component was difficult to be gauged quantitatively. In order to benchmark the component, several aspects had been taken into account: awareness raising, player encouragement, resources sharing and community engagement. Whilst most of the games in the market were unable to show promising results in the Social component, **Make a cup of tea** received positive feedback during the interviews. One of the concerns addressed in **Chapter 9.2** is that the game platform might not be as effective for older generations due to their lack of interest. However, the experiment results show that the technology did not hinder the elderly from benefiting from the platform as majority found the game intuitive and interesting. From here, it can be said that games can be a good platform to engage people from all age groups. **Make a cup of tea** was designed primarily for the dementia family carers in the pre- and early-stages; however, it is also suitable for

people with dementia as well, as well as their family members, because the game can educate them with more knowledge about dementia. In other words, the game serves as a connecting bridge between the people with dementia and their loved ones through a more thorough understanding between each other. **Chapter 9.3** discusses the details of each mini-game and some suggestions for further improvements on the game. In the future, **Make a cup of tea** can be expanded by improving the mini games, creating more linkage with the community, configuring the designs for different stage of dementia and developing games for other mental health issues.

Chapter 10. Discussion and Future work

This research investigated designing games to support family carers of patients at pre- and early-stages of dementia. The literature review discussed digital platforms to support public health issues especially for dementia patients and dementia patient carers. The research identified a conceptual framework for the dementia patient family carers' "need in game". The game **Make a cup tea** has been developed according to this conceptual framework.

10.1 Research Development

The research gap was discussed in the **Chapter 2** literature review, and the research questions which are proposed to help fill this gap. In answering these questions, a framework was created. The framework was developed and the methods that were employed to utilise this framework are detailed in **Chapter 3.**

There are various literature focusing on dementia itself relating to psychological and physiological support. However, dementia family carers are the main people who can affect dementia. The main problems of the carers is they do not get enough of the right kind of support at the right time (Dementia Care Central, 2018). This could produce negative emotional issues as carers can feel isolated, depressed and frustrated (Alzheimer's & Dementia, 2018).

This study is focused on discovering what type of game is effective in helping dementia carers. The literature suggested problems faced by dementia carers could include mental breakdown. Three main methods were highlighted to support and inform dementia family carers: communities of fellow carers, stress-relieving tools, and education about dementia (Dementia Care Central, 2018). In order to provide these services, digital platforms were researched. A conceptual framework with three main themes emerged: social marketing (refer to **Chapter 2.1**), games (refer to **Chapters 2.2** and **2.4**), and social media (refer to **Chapter 2.3**). In this study, the game is the main platform, while social marketing and social media are additional platforms to support the game in order to achieve the social components (Tafesse, et al., 2018). Games can be categorised as

having three benefits: sharing information effectively and creating online communities to enable player to share their experiences, such as helping the carers face the impact of dementia in their own lives (Cutler, et al., 2016); improving the relationship between dementia patients and their carers; and helping to educate people. The games also have the potential to be a type of therapy to relieve the carer's stress and negative emotions (Dekker & Williams, 2017).

The findings of the literature review indicate that caring for dementia patients poses many challenges. Games providing a virtual experience platform to deliver knowledge of health issues in order to support dementia families can help. In the exploratory experimental findings, each framework component supports health issues through games. The game purpose consists of more than one component, and the social component, for example, is particularly complex as it combines online and local community aspects. The social component constitutes additional support in this study. Thus, education and health are the main components and engagement shows significant positive results, also discussed in **Chapter 7.2.2** and **Chapter 7.2.4**. From the experiment results, it can be seen that **Make a cup of tea** positively influences dementia family carers and this study can impact on various other users. The research concepts and framework can be also used for different health issues, as discussed in **Chapter 1.3** and **Chapter 10.6.3**. Accordingly, **Make a cup of tea** can be expanded with various themes and level ups.

The result of this study, and the framework created using the concepts found in social marketing, games and the use of social media, can help to engage users and so help deliver the tools needed to support dementia family carers. Expert interviews and game analysis confirmed and refined the framework. The metric instrument was developed to measure the game's purpose within education, health and social. The result of the exploratory experiments show that the metric instruments are reliable. The **Make a cup of tea** game was created according to the framework. experiments shows that **Make a cup tea** was successful in supporting dementia family carers by increasing the carer's knowledge of dementia and increasing positive relationships between dementia patients and their carers (see **Chapter 9**).

10.2 Answering the research questions

This research addressed two main research questions in **Chapter 10.2.1** and **Chapter 10.2.2**, and each of these main research questions has three sub-questions.

10.2.1 First Research Question

The first research question is to define a framework to identify the important elements in the game for the dementia patient family carer. The sub-questions of this first research question are answered in **Chapter 5 and Chapter 6.1**. The findings in answering these sub-questions are summarised below.

Q1: What is an appropriate framework for informing and supporting carers of people with dementia?

The conceptual framework is based on the theoretical foundation identified through the literature review in **Chapter 2** and further refined and confirmed by the game analysis and expert interviews. There, several crucial elements of the framework, such as the dementia carer's needs, games for change to support carers and encourage engagement, and the communities supporting the dementia patient carer, have all been discussed according to the result of the expert interviews. Furthermore, game analysis has been used to find the most valued type of games for dementia patient carers.

Q1-1. What types of social media games are most effective in reducing carer stress?

According to the expert interviews in **Chapter 5.1**, social community is very important for dementia patient carers. Community support for dementia patient families can facilitate exchange and sharing of resources of various kinds, and this can reduce the stress of being a family carer. The game analysis results in **Chapter 6.1** indicate that games as an entertainment interactive platform can engage players and increase community size. Additionally, games with different purposes can be beneficial in respect to a range of health issues.

Q1-2. How can communities of dementia carers be built?

Based on the expert interviews, the social component is the main element in the framework that can be used to build the communities. However, social components are complex, involving both online and real communities. The ideal is that there is a

connection with the support on offer for dementia patients and their carers at a local social community level in order to engage the players more deeply. In this research, however, the focus is on the games themselves. As shown in the game analysis, there are exciting games that focus on the social component in order to discuss different issues in public health. Hence the challenge here is to use the games as a platform to encourage players to discuss dementia related issues.

Q1-3 What are the education opportunities for carers?

According to the expert interviews, there is not enough educational provision for dementia patient carers, especially for carers of patients at pre- and early-stages of dementia. They may not have sufficient knowledge of dementia or the recourse for support. Additionally, experiences gained in addressing this shortage of provision could open up other possibilities to use exciting game to provide knowledge on various other health issues such as cancer and depression.

10.2.2 Second Research Question

The second research question concerns measuring the games with a Goal Question Metric instrument. Exploratory experiments are discussed regarding the exciting potential of games. Experiments test mock ups of games with dementia patient family carers in order to answer the research question. The findings are summarised below.

Q2: How can the games be used to support carers?

In the exploratory experiment I, various games with three purposes were discussed in **Chapter 7.2.1**. The games can be categorised into three groups according to their purposes, be they health, education or social. The Games for Health are applicable to physiological or psychological needs. The Games for Education are interactive plays that contribute to the user's learning process. The Social Games strengthen the social connectivity of the users and could be useful tools to raise social awareness.

The mock up game **Make a cup of tea** was developed from the exploratory experiments I and II in **Chapter 7.2**. There are positive results from experiments I and II in **Chapter 9**, the GQM method and interviews with dementia family carers. These results show that the mock up game caters for all three categories of needs of the players.

Q2-1: Can games be effective in improving carers' health?

Make a cup of tea is developed to increase the health knowledge of dementia patient family carers. And, according to discussions with dementia patient family carers, as detailed in **Chapter 9.2**, playing the game also increases positive relationships between dementia patients and dementia patient carers. Both can contribute to improving the cares' health and wellbeing.

Q2-2: Can games expand the carer's social community?

In this stage of research, the focus is on the games themselves because social components are complex to measure. However, the feedback from dementia family caters with **Make a cup of tea** in **Chapter 9.2** indicates that games can attract and engage people in discussing dementia-related issues and can help them to find support. Furthermore, positive results have been obtained regarding the social components in the experiment I in **Chapter 9.1** testing the **Make a cup of tea** games with dementia patient family carers. This means the games are successful in encouraging people to talk about dementia.

Q2-3: Can games be used to educate carers?

Based on the opinions expressed in experiment II by the dementia patients' family carers , **Make a cup of tea** is a game platform that can increase a player's knowledge and understanding of the health issues of dementia and can give advice on caring for dementia patients. It is shown to be successful for family carers of patients particularly at pre- and early-stages of dementia.

10.3 Research Implications

The project has the potential of opening up a whole new field of research into games impacting on positive health-related change. For now, research has focused on using digital platforms, especially games to support family carers of patients at pre- and early-stages of dementia. The following outline covers the implications that can be considered based on the findings of this research in designing games for dementia patient family carers.

10.3.1 For the field of dementia carers in game

Games can be instrumental in improvements in self-management and engagement as well as supporting behaviour change. For dementia patient family carers, games could be used for training and behaviour change, whilst research into games for dementia carers looks at the effectiveness of games in helping to modify the carers' behaviours and improve their knowledge of dementia. Once a carer understands dementia as a condition, they can find the best way to look after dementia patients based on that understanding. Dementia is a major cause of disability in older adults. Caring for relatives with dementia can have a significant effect upon their physical and psychological health. In terms of public impact, awareness of dementia can be raised by using digital platforms to advocate for action, and such awareness will help address the real needs and concerns of people with dementia and their carers.

10.3.2 For game researchers

Games research is a strategic research area in the UK within a high growth, high value and highly successful knowledge-based economy. It also has outstanding potential for future innovation and growth in the UK. As the research is designed to discover how games and other technologies can be used to support dementia patients and their carers, it will have an impact on the academic community by contributing to health and social care research, as well as shifting understanding and advancing scientific, methodological, theoretical and practical applications across several disciplines ranging from game design technologies to health and social care studies. Furthermore, the metric instrument has been shown in the research as a reliable tool for measuring games.

10.3.3 For game designers

In this project, practical research has been combined with theoretical knowledge as the latter can be used to deliver a specific and strategic innovative project with a strong knowledge base. The research designs the real game platform by creating a mock up game for demonstration. **Chapter 8** discussed the game design for dementia patient family carers in two sections. In the first section, the game design, the relevant skills and challenges, as well as game player's motivation were discussed. The second section explored **Make a cup of tea** regarding its game system, content and purpose.

10.4 Research Limitations

The limitations encountered during the research included paucity of resource, participant's personal issues and games choice, etc. These issues inevitably affect the results.

There are various games marketed towards dementia patients. However, there are limited references for carers in both academic research and real community support. Social components are highly complex to test out, which means relying on exploratory experiments. It is difficult to conduct testing with game professionals on six. Participants can lose their patience or may not have time to complete the tasks. Dementia is a sensitive topic, and most people avoid discussing the issue. Hence, it is a challenge to find participants. This research focuses on dementia patient family carers who might need to deal with different emotional responses before taking part in this study.

There are no games in existence at the moment for dementia patient family carers. Therefore, the initial exploratory experiments had an unexpected result, and further experiments had to be further refined to focused on the meaning of the games with metric instrument. Eventually, the result of the exploratory experiments led to developing the game **Make a cup of tea** to achieve successful direct impact in the viewpoint of dementia patient family carers.

10.5 Research Conclusion

The project has the potential of opening up a whole new field to support dementia family carers through games. As shown in **Figure 10.1**, there are three stages in this research. These are discussed below.

The first stage focuses on the construction of the conceptual framework. detailed in **Chapter 2** identifies digital platforms and dementia patient carer's needs according to the literature review. The limited existing research and items to support dementia patient family carers are the main issues which indicate a gap in the research and market. The following chapter, **Chapter 3**, presents the development process of the conceptual

framework based on the literature review. The nine elements in this group have three components which include social, health and education of carer's need and three platforms as games for change which include social marketing, social media and game. Additionally, engagement is an important element in supporting dementia patient family carers and encourages users to become involved in platforms. **Chapter 4** discusses the methodology for the validation of the conceptual framework and decides the triangulation methodology to confirm and refine the framework with expert interviews and game analysis. The conceptual framework is confirmed and refined through a series of expert interviews with eleven participants in **Chapter 5.1**and game analysis with twenty games in **Chapter 6.1**.

The second stage focuses on the exploratory pilots following the confirmed and refined framework. **Chapter 6.2**, discusses the metric methodology including development of the metric instrument, piloting, exploratory experiments, design of games and experiments. The metric instrument with a metric table and GQM method applied to the game and framework elements are developed in **Chapter 7**. The following discussion concerns piloting and exploratory experiments in **Chapter 7.2**. The purpose of piloting is to uncover the potential flaws and exploratory experiments within the two phases. The result of exploratory experiment I indicates that data was not normally distributed. However, this study discusses the interesting result in each game's purpose. Exploratory experiment II had to be tested with larger number of participants in order to show significant results to prove that the metrics table is reliable.

The third stage, concerns the design of games for dementia patient family carers according to the results of the exploratory experiments. This is discussed in **Chapter 8**, this stage concerns the mock up of the **Make a cup of tea** game and discusses issues of games for dementia family carers such as game system, game content, and game purpose. The purpose of this section is to reveal a new development in games to support dementia patient family carers, and to test with dementia patient family carers and to hear their voices directly. In **Chapter 9**, experiment I tested **Make a cup of tea** with twenty participants who are dementia patient family carers with the metric instrument and experiment II consists of interviews with twelve dementia patient family carers. The results are positive.

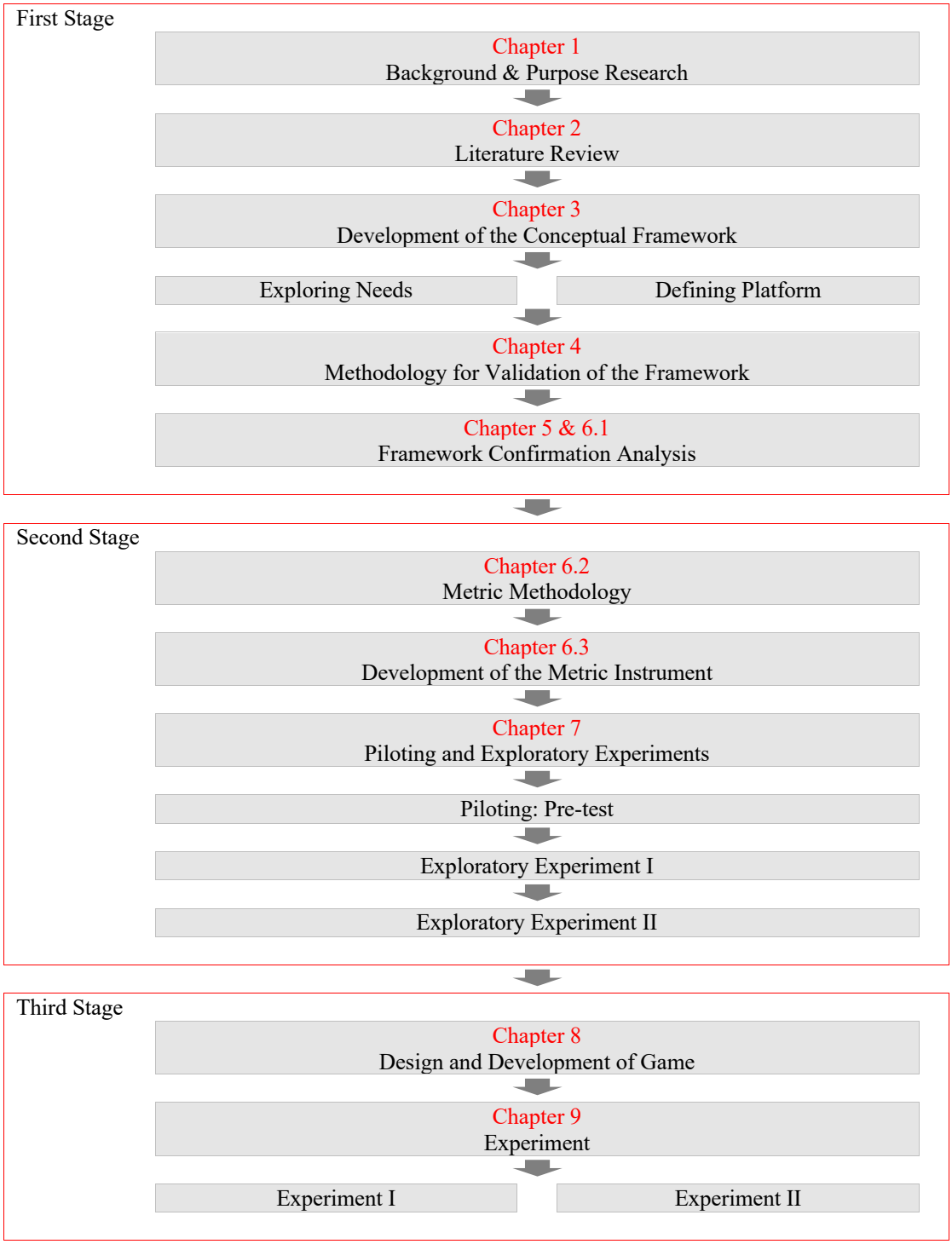

Figure 10.1: Summarises the work completed by this research

10.6 Research Contributions

There are three main contributions made in this research including the conceptual framework, the metric instrument and the **Make a cup of tea** game. The framework

was designed as a theoretical concept; the metric instrument was developed as a tool for measuring games; and **Make a cup of tea** is a mock-up game to demonstrate dementia symptom to dementia family carers.

10.6.1 Conceptual Framework

The conceptual framework is designed for the dementia patient family carers based on their needs and the appropriate digital platforms to support them. The results confirmed and refined framework content by game analysis with twenty games and expert interviews with eleven participants. These incorporated the following contributions:

- A critical analysis of appropriate literature relating to dementia carer's needs and digital platforms for the structuring of support for family carers of patients at pre- and early-stages of dementia.
- The synthesis of disparate theories of dementia patient carers in games structuring into a cohesive whole.
- A list of three components of support for the dementia patient carers, three platforms and a main element, confirmed by experts.

10.6.2 Metric Instrument

The metric instrument was developed and tested to support the measurement of games for the support of family carers of patients at pre- and early-stages of dementia. Exploratory experiments tested six games with five experienced gaming professionals and a game with thirty-five participants who are gaming experts to identify and prove that the metric instrument is reliable, including the following contributions:

- A demonstration that the metric instrument can be used to derive a measurement tool for health issues especially for dementia patient family carers.
- An application of the instrument with various health issue related games to validate the metric instrument for reviewing complete games for health issues especially for dementia patient family carers.

- An exploration of the health issues for family carers including considerations of needs to be taken into account for them in future work.

10.6.3 Design and Development of the Game: Make a cup of tea

Make a cup of tea is designed and developed for family carers of patients at pre- and early-stages of dementia. It is based on the framework and the results of the exploratory experiments. **Make a cup of tea** was tested in two phases. First, in experiment I, it was tested with twenty participants with the metric instrument. Secondly, experiment II consisted of interviews with twelve participants. The experiments generated positive results. The incorporated results are discussed below:

- Mock up games opened up a new field as an important step for health issues, especially for the issues that concern dementia patient family carers.
- **Make a cup of tea** generated a successful result from experiment I. From the metric instrument, the result shows the games have met the three purposes suggested by the hypotheses to be needed to support dementia patient family carers.
- **Make a cup of tea** can successfully increase knowledge of health issues according to the results of experiment II interviews.

10.7 Future Work

This research is focused on the game itself for family carers of pre- and early-stages of dementia. There are various ways to proceed based on the research results. Three of the main recommended directions for future works are discussed below:

10.7.1 Expanding Make a cup of tea

Make a cup of tea is a mock up game, sufficiently effective to demonstrate the idea. However, it requires improvements before entering the real world market. **Make a cup of tea** incorporates mini games as a tool to make a real tea in the English cultural tradition. There are many possibilities for expanding this for other personal interests, such as gardening, according to the dementia patient carer's advice in experience II in **Chapter 10.2**. Additionally, as the current design is for carers of pre- and early-stages

of dementia, the next step can be expanding to carers of patients of middle or late stage of dementia.

10.7.2 Social component

Whilst this research focuses on the game itself, future expansion could involve social platforms such as social media or local communities. Social engagement provides a physiological and psychological impact which will improve health behaviours. The social network allows players to interact with friends, establish relationships and engage in teamwork to achieve support for each other. These are key success factors for the innovative and effective nature of this project. This project will help communities, charities and society at large in raising awareness of dementia. The combination of online and local community associated with the game will help dementia patients and carers directly. This project will start in Hampshire and expand into the whole of the UK.

10.7.3 Expanding for family carers dealing with other health issues

The purpose of the game, including education, health and social elements, is to help dementia carers. Games provide a platform to help patients understand themselves and provide guidance for their friends and families. The research could also be applied to different health issues, especially mental health. There are many health issues which are similar to dementia. Examples of these include:

- Post-traumatic stress disorder (PTSD): This type of anxiety disorder is very similar to dementia; PTSD patients can lose their memory, for example. There may be treatments for this type of mental health to help patients get back to normal life (Verghese, 2000).
- Schizophrenia: The seriousness of this type of mental health issue depends on how well patients can cope with it. Family and friends play an important role including listening and helping out with their daily life (Shepherd et al., 1995).

10.8 Final Remarks

The research is a multidisciplinary project involving digital design, computer science and healthcare studies. The intended contribution of this research is to improve the

living standards of dementia patient carers by educating and enlightening them through games. The design of the conceptual framework is based on theoretical reviews to solve the problems of dementia patient family carers. The results of the conceptual framework are confirmed and refined by games analysis and interviews with experts. The creation of the metric instrument consists of measurement tools to determine how the games can support dementia patient family carers. Metric instruments are proven to be reliable from the exploratory experiments. Based on the results, the design of the **Make a cup of tea** game is a mock up to demonstrate the ideal support for dementia patient family carers. **Make a cup of tea** had positive results thereby enhancing the suggestions for future expansion.

There are a range of possible expansions for future research in this study, including different stages of dementia, expanding the social component combining online and local communities or expanding for various other health issues. At this stage, the research relates to pre- and early-stages dementia. For middle and late stages, there might be different specific needs. Games can be used for different purposes, for example, for family carers dealing with mental health issues. The local community benefits groups of people with the same issues or interests who live in a common location. Local communities are difficult to build up. However, the main challenge is to start to run different local community groups and provide specialised support for dementia carers. The most valuable local community is that which is linked with online platforms, as online platforms can rapidly spread information. The impact of the research will be shown in improvements to the quality of life of people, especially for family carers of patients at pre- and early-stages of dementia. Playing the game will have a positive impact on the wellbeing and quality of life of the player.

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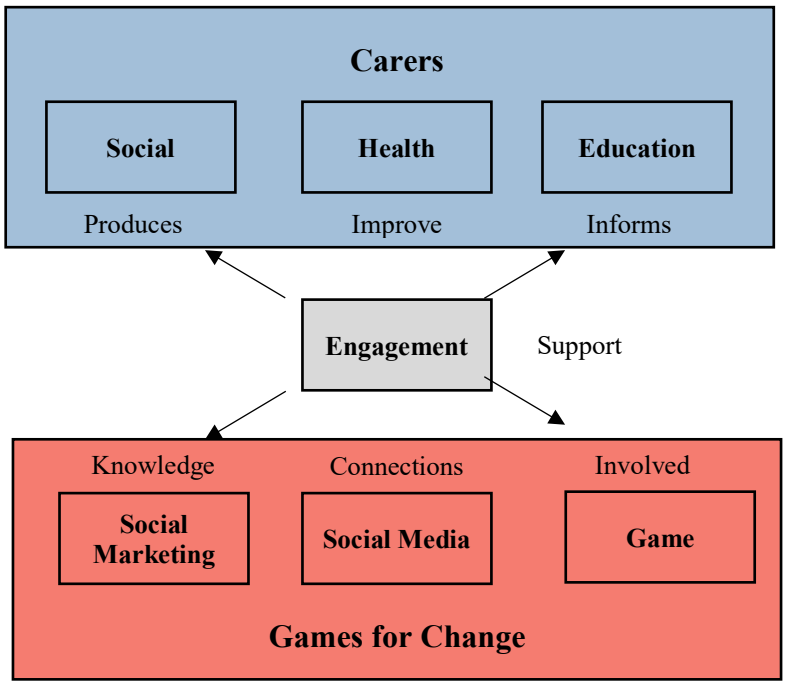
Appendix A: Expert Interview Questionnaire

Participant information

I am currently researching the factors which influence the creation of a social game for dementia patient's carer. Based on the background research completed; I have created a framework including three elements: social, health and education, which I think relate to the **carers** needs. Another 3 elements: social marketing, social media and gamification are related to the **Games for change** which will be created.



General question

The following questions are general questions about the framework. Please feel free to express your personal opinions

1. What factors are missing from this framework?
2. How could I make my framework better?
3. Do you have good and bad examples related to my research?

Carers

The following questions relate to carer's needs. Please circle on answer.

1. Is there much available in the market to help dementia carers in their life and work? Please could you give me some examples?	Strongly Disagree	Disagree	Agree	Strongly Agree
2. Do you think they cover every aspect that is needed?	Strongly Disagree	Disagree	Agree	Strongly Agree
3. Do you think games educate people in a fun way? Are there some good examples?	Strongly Disagree	Disagree	Agree	Strongly Agree
4. Do you think games reduce peoples stress and teach users? Are there some good examples?	Strongly Disagree	Disagree	Agree	Strongly Agree
5. Do you think social media leads to online communities being formed increasing the size of a person's community? Are there examples of this happening	Strongly Disagree	Disagree	Agree	Strongly Agree

Intervention

The following question relates to interventions, which may be created in the future. Please circle on answer.

1.	Do you think an game for change which involves: social marketing, knowledge transfer, social media connections, and gamification could engage people and change their behaviour and thinking?	Strongly Disagree	Disagree	Agree	Strongly Agree
2.	Do you think social marketing has been used to change people's behaviour and increase their engagement in the past?	Strongly Disagree	Disagree	Agree	Strongly Agree
3.	Do you think social media could be used to build up an online community of carers?	Strongly Disagree	Disagree	Agree	Strongly Agree
4.	Do you think social media could increase the engagement of dementia carer's on a website or game and so help broadcast a message on health issues?	Strongly Disagree	Disagree	Agree	Strongly Agree
5.	Do you think the increasing game of products is an increasingly popular choice and leads to more engagement with users?	Strongly Disagree	Disagree	Agree	Strongly Agree

Engagement

The following question are focused on who would want to use these elements to engage people. Please circle on answer.

1.	Do you think engagement is the key thing to help dementia carers build up an online community, deliver education and reduce their stress?	Strongly Disagree	Disagree	Agree	Strongly Agree

Appendix B: Games Details - Game Analysis

Aviation Empire[31]

The game has 4 million Facebook fans and has been downloaded around 180,000 times by players from 147 countries. This game allows a user to connect with other users socially using social media to share game credits and performance data. A user can also compete with other friends in the game.

Game play

Aviation Empire is a strategy game where the players run their own airline. The target of the game is to choose the airline's destinations, invest in aircrafts, design airports and create an airline. This game is connected via GPS to allow check-in functionality in over 70 airports.

Avatar portrayal

A player logs in via their personal social media account, such as Facebook or Twitter. The game syncs with the users social media account, and then updates the user's picture in line with their social media account. There is no additional character or avatar for the players to choose.

Game world graphics

Aviation Empire is not a virtual reality game. However, the game play is similar to the real world. This game creates a bridge between the real word and digital world. The graphical design is 3D, with 2D characters

Sound/Music

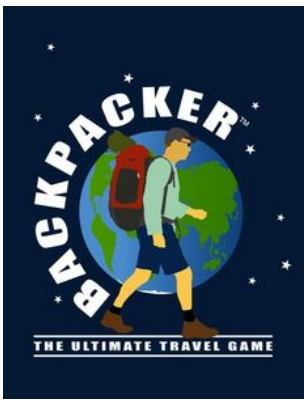
The background music mimics that of a real airport in an attempt to make the game as close to reality as possible.

Storyline

This game offers the player the experience and complexity of running an airline. The game starts from the foundation of KLM in 1919. Players start by developing their destinations and expanding their fleet of airplanes.

[31] https://game.klm.com/aviationempire/

Backpacker[32]



This is a card game, based upon traveling the world. The game highlights problems which may be experienced by people who travel for long periods, such as sickness or lost money. There are two types of card: country picture cards and event cards. The aim of the game is to get back home safely with pictures of as many countries in disparate continents as possible.

Gameplay

The cards received by the players are based on luck. However, it depends on the players' strategy to choose which cards to keep, the order to play them and when to return home and bank points. While playing, the players visit different countries and continents, trekking, wildlife, beaches and meet other friends. The players might also need to cope with the problems such as delays, sick and dangerous situation.

Avatar portrayal

Players are unable to choose the avatar for their character.

Game world graphics

The game word is portrayed by a mix of real life photos and informative graphics. The game allows the players to explore the world and face different problems.

Sound/Music

As it is a card game, there is no background music. Players are able to play any music they want in the background. During the card game, players will be excited about their future game prospects and will talk to each other or switch cards.

Storyline

Backpackers can gain insight into the feeling traveling around the world gives, the problems they would face and how they could deal with them. Event cards show the extra things travellers are able to do on their journey in order to earn get bonus points. Bonus cards include sampling the culture, trekking and exploring the wildlife.

[32] http://www.backpackercardgame.com

Cancer Game[33]

Cancer Game explores the story of cancer. This game is created for general players to explore the symptoms and causes of cancer. It educates the players about good eating habits, mood and living habits.

Game play
The game uses a point-and-click interface to control the character. The game has five levels, with the objective to find the key. The main aim is to find the 5 keys to win the game.

Avatar portrayal
The game's main purpose is to deliver messages; there are no characters for players to choose from. The sole character in the game is a simple little person, not showing any gender, style, etc.

Game world graphics
The background is in the form of a factory, where every part of the human body shows different tools. The game design uses a cartoon style, combined with actual pictures, such as burgers and vegetables.

Sound/Music
The background music has different sounds in different levels with different environments. It uses actual factory sounds, such as light switch, and machine working sounds.

Storyline
The general story showcases the healthy living habits. Each of the 5 levels shows a different story. For example, Level 1. Lung: No smoking; Level 2. Liver: No Alcohol; Level 3. Stomach: No Junk food; Level 4. Intestines: Good eating habits. Level 5 (complete game): Good eating habits, mood and good living habits.

[33] http://veevia.com/project/Cancer_Game/index.html

Cortex Challenge[34]

This is a board game which tests a person's mental agility. It includes eight types of challenge which test a person's cognitive ability in different ways: their memory, maze solving, colour recognition, coordination, pattern matching, quick counting, reasoning, and a touch challenge. This game is suitable to all players especially for children and older adult for the brain excise.

Gameplay

A card is turned over and all the game's players race to determine the correct answer and slam the card. Once a player has correctly answered two cards which test the same brain function, they can collect a piece of the brain's cortex. The first player to complete their brain jigsaw wins the game.

Avatar portrayal

Players are unable to choose an avatar for their character. However, during the game players have to win the four pieces of brain which is represent the different part of brain controls the different functions of the body.

Game world graphics

The game trains different functions of the players' brains. The game design brings elements of the real world, such as animals and daily essentials, to the gameplay. The touch challenge is designed to mimic the touch feeling of certain objects with actual photos, such as a basketball, wood, peach, etc.

Sound/Music

As it is a card game there is no background music. During this game, the players will be excited and rush to answer the challenges.

Storyline

During the game, players collect cards representing different types of brain function. Each function has a different type of challenge. The game tests thinking speed and memory skills. In this game, a player uses their brain to solve different tasks, such as a touch test, duplicates, logical series, mazes, colour, puzzles, etc.

[34] http://www.esdeviumgames.com/featured-product/cortex-challenge/

Elude[35]

This game was created by Singapore - the MIT Game Lab. It is a collaboration with the Massachusetts Institute of Technology in the USA. This game raises awareness of depression among family members and friends, and explores the complexities of their mood.

Game play
The game uses keyboard controls. Players can walk and jump. Players need to jump to the sky, but might fall in the darkness space.

Avatar portrayal
The player is not able to choose the avatar. The avatar is a depressed boy who explores the world. In the game, each character is very meaningful.

Game world graphics
The game shows 3 different moods. For example, the forest represents a neutral mood; the sky represents a happy mood; the depths of the earth represents depression. This game uses the background design to show the person's mood. Colourful birds represent different thoughts.

Sound/Music
Background sounds with nature sounds, such as birds, wind and leaves. The character will make sounds like walking and sighing.

Storyline
The game shows the different moods of people who are depressed, allowing their friends and family understand depression.

[35] http://gambit.mit.edu/loadgame/summer2010/elude_play.php

End Game: Eurasia[36]

Endgame:Eurasia is a news game which is developed by Auroch Digital. It is an interactive game about the ongoing war in Syria, where the people are still suffering as of today. This game attempts to explain the complex situation of the Syrian civil war.

Game play
This game explores the actions that affect the military and political conflict. The game is designed such that it looks like a classic board game. The game consists two phase: the military phase and political phase. Players will receive random cards and click on different menus and texts to play. They need to think about the costs and when to accept a peace treaty. The game aims to educate player while presenting it as an entertainment.

Avatar portrayal
There is no avatar to choose. There are regimes and action cards for the players to choose from.

Game world graphics
The game design uses simple symbols in the cards chosen to play.

Sound/Music
The background music incorporates an element of fear, which is suitable for a war game.

Storyline
This is the actual situation happening in the Syria war. The game shows the situation in Syria and how to fight the war. This game discusses the war, political parties, history and Syria issues which is suitable for all age groups to understand the global issues.

[36] http://gamethenews.net/index.php/endgame-syria/

Fugue[37]

This game is one of the projects developed by the MIT Games Lab. Players need to think about the questions the game asks. In order to answer those questions the players have to create their own characters and express their thinking through the game.

Game play

At the beginning, Players choose their persona from a list of characters with different meanings and abilities. In the game the players need to choose the places they would like to explore and play different persona cards in an attempt to solve the problems encountered. The players receive tarot cards and need to choose which one to play when they face different issues. It is an adventure game with point-and-click controls. *Fugue* involves the user in actions of a physiological nature, including daily activities such as hunger, thirst and resting.

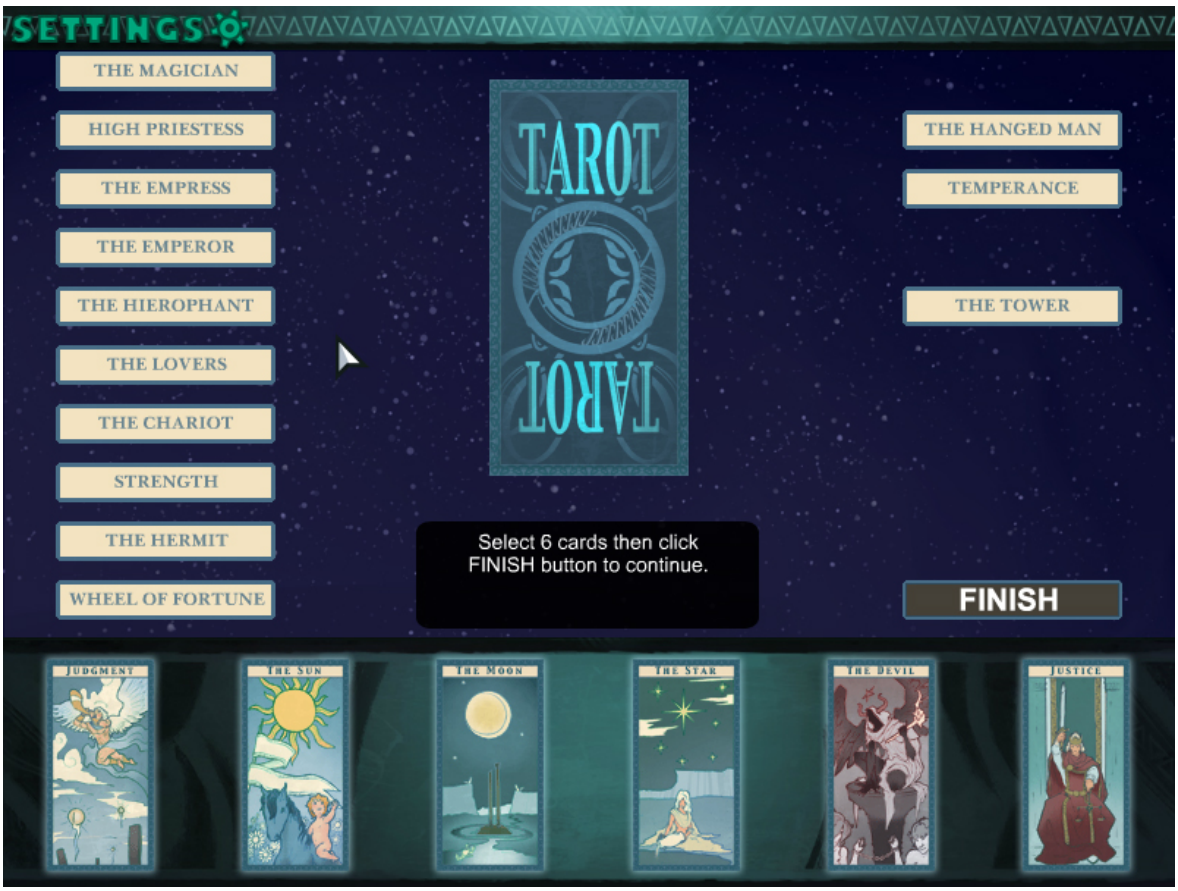
Avatar portrayal

The players choose their own persona. For example, they may choose to be the Empress, the Chariot, the Devil or the Moon. Different cards have different pictures and endow different powers to player. For example, the High Priestess's power is the ability to put the player in the shoes of another player; empathy is a great virtue. The Star's power is to show another player generosity; all favours are rewarded.

Game world graphics

The game uses different icons from magic tarot cards. The design is influenced by Greek mythology combined with a cartoon-like style. In the game, the designer tried to incorporate images from the real world, such as real people, trees, villages and tigers.

[37] http://gambit.mit.edu/loadgame/fugue.php



Sound/Music

At the beginning, the light music is played depending on the choice of persona. During the game, the background music enhances the magical element in the game world.

Storyline

Fugue explores the fantasy world guarded by a "Maiden of the Fountain". Throughout the journey, the players choose different tarot cards which will influence their travel's outcome. A player who chooses to be a benevolent and kindly person will face different issues as compared to a player who chooses to become a clever trickster.

Homeland Guantanamos [38]

The game is about human rights; it involves the real story of Boubacar Bah. He died in 2007 in U.S. Immigration & Customs Enforcement custody. There are 300,000 people in immigrant detention due to unfair Department of Homeland Security policies.

Game play
It is a 3D user experience game. You can go to different facilities, and it shows the actual situation in the custody. The players role-play an undercover journalist to investigative series to uncover the truth. At the beginning of the game the players are given information about Boubacar Bah. Then, the players are able to choose where they want to start from the facility map such as visitor's room, office, medical unit, solitary confinement, cell, restrooms and common area. Each room shows its respective environment as well as its associated stories that have happened to different families.

Avatar portrayal
There is no avatar to choose from; the player takes the role of a journalist to find out the truth of Boubacar Bah issue. The game comes with a few videos of the actual person describing their experiences.

Game world graphics
The game uses 3D design to show the actual environment of the detainees. The game also involves the actual persona discussing their experiences in the custody.

Sound/Music
There is not much background music. However, there are actual people talking, such as describing the real conditions in the custody.

Storyline
This game highlights the human rights of the detainees in U.S. Immigration. This game aims to stand up for human rights with proved evidence.

[38] http://www.homelandgitmo.com

Ice Flows[39]

Ice Flows is part of research project which is founded by the Natural Environment Research Council led by the British Antarctic Survey alongside with the University of Exeter. This project highlights the climate change issues. The game shows the Weddell Sea region of Antarctica and the global sea-level in the near future. The research partners include: National Oceanography Centre, Met Office, UCL, University of Oxford and Alfred- Wegener Institute.

Game play

The game has two parts of control; the left hand side controls the snow and the right hand side controls the temperature. The players need to adjust the ice flow in order for the penguins to high five the albatrosses, and at the same time they need to control the sea temperature such that penguins are able to dive into the sea to hunt for food.

Avatar portrayal

The game's avatar is a penguin. There is no character to choose. The character is a simple little person, not showing any gender, skin colour or any style.

Game world graphics

The game uses a cartoon style like Ice Age to build up feeling for the Weddell Sea region of Antarctica. The design includes penguins, fish, birds and sharks.

Sound/Music

The game has light background music, and moving music when moving the snow level or sea temperature. When is near the finishing time, a timing voice will sound.

Storyline

This game is telling the story of climate change and what will happen in the Weddell Sea region of Antarctica. In the game, there are mini Q&A games related to climate change. It educates the player about the actual situation that is happening in the Weddell Sea region of Antarctica.

[39] http://www.iceflowsgame.com/index.html

Inside the Haiti Earthquake[40]

This game is a documentary-type game that documents real life events. *Inside the Haiti Earthquake* presents what actually happened in the 2010 Earthquake in Haiti. This game won several awards: Winner - 2011 Horizon Interactive Awards (Best in Show); Winner - 2011 Horizon Interactive Awards (Best in Category); Winner - 2010 Applied Arts Interactive Awards (Gaming); Nominee - 2011 Webby Award (Best Writing in Online Film & Video); Nominee - 2011 History Makers (Best Interactive Production); Nominee - 2010 Canadian New Media Awards (Best Web-Based Game); Nominee - 2010 Social Impact Games (Best Social Impact Game).

Game play

Players can pick a storyline based on three different roles: the aid worker, the survivor and the journalist, each having different stories and challenges. The game presents players with multiple-choice questions with few choices to pick from to face the challenges caused during the earthquake. For example, one survivor question is: "Your tools are rudimentary, and the concrete is too heavy for you to move." The player can choose "Walk downtown to look for help" or "Stay by your house and wait for help."

Avatar portrayal

Players cannot pick the gender, age, skin colour, etc. of their avatars; instead players choose the role they want to play and re-live the earthquake experience from different perspectives. Each role presents a different story.

Game world graphics

Inside the Haiti Earthquake uses a documentary film style; the game even contains a real video of the earthquake in Haiti.

Sound/Music

The background music is based on the documentary video of the earthquake, with real people in panic caused by the earthquake describing the events, while the sound was taken from the actual sounds of the cars, airplanes, and the destruction. The background music and sound allows players feel the actual experience of being inside the earthquake in Haiti.

Storyline

Inside the Haiti Earthquake tells the story of the 2010 earthquake in Haiti. The game is a serious, documentary-typed game designed for social change. The game depicts the actual difficulties and challenges of reconstruction after the earthquake. There are three different stories that depend on what fate the player picked to play, and they document the three different perspectives of what actually happened in the 2010 earthquake.

[40] http://www.insidedisaster.com/experience/Main.html

Let the Cat in[41]

Let the Cat in was released on Steam in 2015. This game can also be played online with the App store and Google Play and links it with Facebook. This game is helping homeless animals through donating 15% of the revenue to the Petfinder Foundation. The game is available in 8 different languages, such as English, Spanish, Russian, Ukrainian, French, German, Italian and Chinese.

Game play
This is a puzzle game. The game will also guide you through the gameplay. Basically, the player needs to get the cat in the house and collect the stars (or buy the stars with real money). The final part of the game involves cuddling and falling asleep in the lovely house. The player's score can encourage completion with other players.

Avatar portrayal
No avatar can be chosen. The main character is a cat and there is an elder lady which is the house owner.

Game world graphics
The game is designed as a cartoon with an actual house environment, including doors, chairs, stairs, etc. Players have to help the cat to get into the house reach their favourite basket and fall asleep.

Sound/Music
The background music is cheerful, and combined with the rain and cat sounds. It gives player a sense of being in the real environment.

Storyline
The game is an advertising donation game for helping stressed animals. This game intends to get humans to rethink the problems of stressed animals.

[41] http://store.steampowered.com/app/369400/

Pokémon GO[42]

Pokémon GO was created by Niantic, Inc. in 2016. In the short time since being released it has already attracted 7 million players. This game augments the real world with a virtual world. The players of the game aim to find and catch wild Pokémon. The game's theme was inspired by a series of popular role-playing video games and a TV series of Japanese anime first broadcast during 1997. The franchise has already created products using the medium of film and card games.

Game play

This game gives people the chance to look around and explore the outside world. Players catch, hatch, and evolve Pokémon, gradually completing different levels and enabling more powerful Pokémon to be caught. Pokémon eggs slowly evolve in proportion to your distance walked, and battles can be fought and defended.

Avatar portrayal

The players choose their own avatar attributes, such as gender, hair style, skin, eye colour and also outfit. Once the players have created their own avatar, they can start to play the game.

Game world graphics

The virtual world of the game connects with the real one via augmented reality technology. In the game a player's device's GPS capability allows the players to be located in the real world. Different caught Pokémon have differing fighting abilities and special powers which can be used against other players in the gym. The Pokémon characters are inspired by different types of animals. The main character is Pikachu, whose inspiration may have come from rodents such as Pika, Chinchilla and Ailurus fulgens.

Sound/Music

The background music adds to the atmosphere and gameplay, giving the user feedback during gameplay and interactions with different games.
The five famous songs in the Pokémon GO soundtrack are: Pokémon Theme,Pokerap, Pokémon Johto, Go Pokémon Go, I Want to Be a Hero
The music helps encourage the player to be brave, challenge other players and explore their world.

Storyline

This game gives the players an additional justification to explore the real wold, such as the museum, the theatre or a monument. Duringthe gameplay, the user may gain information about different buildings and their history or any special story connected to them. Some restaurants and pubs advertised that there was a Pokémon stop in their shop. This game combines looking after a virtual pet and connects the players with the actual environment.

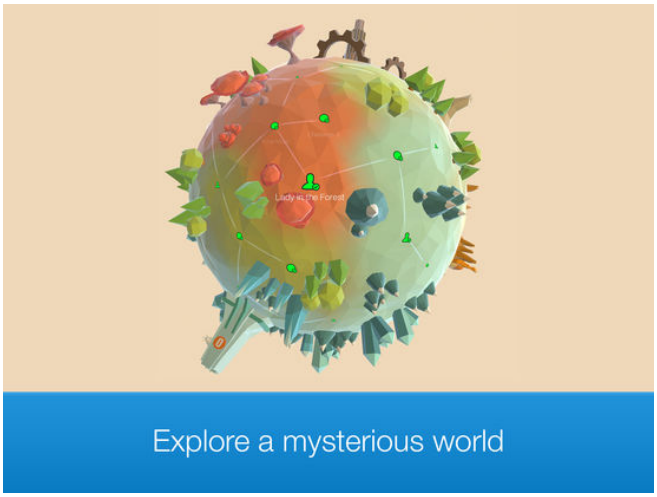
[42]https://www.pokemongo.com/en-gb/

ReachOut Orb[43]

ReachOut Orb is a serious game designed to improve the education and health of students aged between 9 and 10 years old. This game helps students in five main areas:
Mental fitness and wellbeing
Understanding how to maintain a positive mind-set
How to identify and use their strengths
How to develop and sustain positive relationships
How to build resilience.

Game play
The *ReachOut Orb* records 3 good things about the players' day and the reasons they were good, encouraging players to be positive about life. This game combines interesting and positive psychological tips and teaches persistence and perseverance through short games and challenges. This game improves the teenager's wellbeing, encouraging positive thinking and getting through challenging situations.

Avatar portrayal
New players uses their personal email and password to register and create their avatar name. The players can create their own avatar by choosing 3 character strengths related to their personality. The avatar can be customised from many different types and colours.



Game world graphics
The game visuals centre on a virtual world. Player's avatars are informed by their personality and they travel around the digital world with the aim to save the world. This game uses soft colours such as the lighter shades of green, blue and the background colour of blanched almond, which is not dazzling to the players' eyes or as dark as the background used by some horror films. The light hues of colour are suitable for the young age of students because they are not as colourful as those used for young children or as dark as those sometimes used for adults.

Sound/Music
The background music is similar to the music played in science-fiction films about outer space with plots that involve saving the world. When a player moves to another location in space, a sound effect of a moving space craft is played.

Storyline
This game takes place in a mysterious world where students embark on a journey. In the game, students have to resist a negative force called "The Glitch". The player has to interact without being affected by the negative traits of different personalities.

[43] http://au.professionals.reachout.com/orb

Re-Mission 2: Nanobot's Revenge[44]

The game *Re-Mission* was researched by Hope Labs in conjunction with Stanford University. The game is based on the research on the cancer patients and their doctors as well as nurses. This game aims to aid young patients' psychological health, fostering positive emotions, increasing their self-efficacy and encouraging positive attitudes about chemotherapy. This game is made available for those who have had cancer and their families. It aids healthcare understanding and is a positive way to fight cancer. The game helps people to understand how cancer affects their bodies and how different treatments combat cancer along with the treatments side effects.

Game play

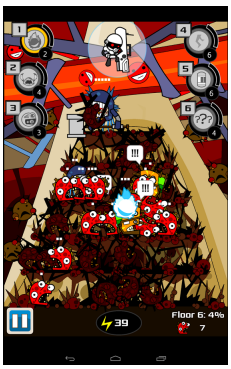
This game is a shooting game, which allows players to choose their tools, such as chemo, radiation and a targeted cancer drug to help destroy cancer by burning, slashing and vaporization. The game shows how to defeat cancer.

Avatar portrayal

In this game players are not able to change their character. However, they can choose where to fight cancer within the human body. The central character is a virtual human who has a gun, enabling players to shoot the cancerous cells.

Game world graphics

The game creates a world out of blood vessels and cells. There are healthy cells and cancerous cells. The graphical style aims to reflect the virtual world. The game environment is designed as similar as possible to a person's real body by depicting different organs such as blood vessels.



Sound/Music

The music reflects the hard challenges and difficult situations faced by the character. It is quiet, frantic and wispy. The game produces a virtual shooting sound when you are shooting and causes the player to feel nervous. The background music adds to atmosphere, which is similar to a dark and dangerous place.

Storyline

Within the game, different cancers are combated by the user using different tools to kill malignant cells. Players need to stop the tumour from growing before the cancerous cells spread to the blood stream. This game supports the players by encouraging patients and their family to face the treatment.

[44] http://www.re-mission2.org

Sea Hero Quest[45]

The game is created by GLITCHES LTD and supported by scientists from the University College London and the University of East Anglia, as well as being linked with people at Alzheimer's Research in 2016. It is very popular and has been played by 2.5 million people, as reported by BBC News on 17th November, 2016[46]. The aim of this game is to help scientists tackle dementia. One of the symptoms of dementia is the loss of navigational skills. When you play the game, navigational data is tracked anonymously, stored securely and combined with other players. This game can be used by new diagnostic tools and in treatments for dementia.

Game play

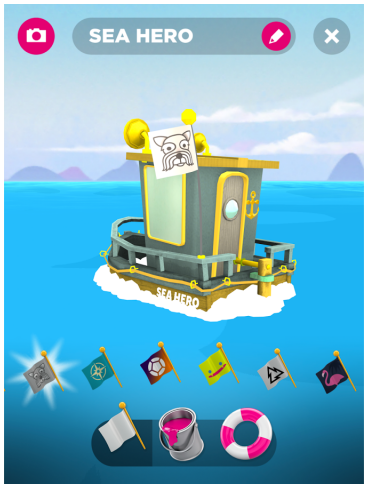
Users in the game have to memorise the map and find the check points. Different levels have different targets such as: "*find the second missing piece and the way will be revealed; Shoot a flare back to the buoy so you won't get lost".*

Avatar portrayal

The player can set their own personal information such as gender, age, country, writing hand, education level, daily travel time, navigating level, sleep average hours, and environment grown up in.
The player can write down their own name and choose their flag and colour. Players who gain more points will have more selections.

Game world graphics

The game world's graphic is based on cartoon style which is similar to the film *Ice Age*. They use a colourful style to show the happy journey. The background shows a realistic polar bear and penguin.



Sound/Music

The background music combines well with the background art. It is like the film style of the actual world. This type of music helps the player immerse themselves in the game's world, although the player is unable to choose the music they would like. The background music type is ambient, which doesn't change too much but reflects the situation of the gameplay; for example when the user is driving a boat, they hear the sound of sea, helping to give the feeling that they are actually in the sea driving the boat.

Storyline

Sea Hero Quest gives the story of a nautical adventure featuring sailors who have lost their memories. The gameplay centres on desert islands and icy oceans, during which the player needs to remember their route and their direction.

[45] http://www.seaheroquest.com/en
[46] http://www.bbc.co.uk/news/health-37988197

SideKick Cycle[47]

The game is from the Global Gaming Initiative. The game is a cycle racing game. The idea of the game is to help the children for their transportation to school. In Ecuador, children have difficulties to attend school due to the lack of affordable transportations. Thus, the World Bicycle Relief promises to send a bicycle to an impoverished community for every 387 of downloads of the game.

Game play
The game uses simple touch controls. The player needs to get as many coins as they can. During the game, players might face the problems of how to cross certain obstacles.

Avatar portrayal
Players can choose a character with different gender, skin colour, style of wearing; when the player gets more points, they can buy more equipment.

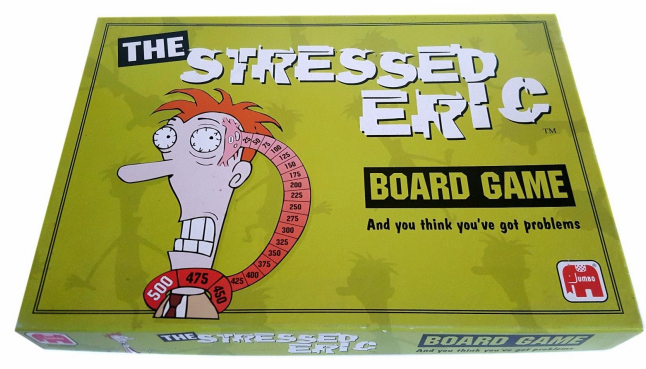
Game world graphics
The graphics feature a simple design of the character and background of the village.

Sound/Music
Background music with cycling sounds. Different situations will prompt different sounds; for example, a sound triggers when the player gets a coin, and when the player falls down, a crush sound plays.

Storyline
The game is more of an advertising game to donate bicycles. The game gives the message that some people in the world might be living poorly, even having problems go to school.

[47] http://globalgaminginitiative.com/sidekick-cycle

Stressed Eric[48]



This game is based upon a British cartoon produced by the BBC. The game is about a middle class man called Eric. He always stressed in his life about his family and work amongst other things.

Game play
Each player puts one Eric on the start and one on the Stress-o-meter at the 300 stress point. The game play is similar to *Monopoly*, where dices are rolled to advance the player through different situations. Each player will face different situations which affect their wellbeing positively and negatively. When the situation is stressful, the stress point will increase, and vice versa. The game is played by chance, hence there are not many options for players.

Avatar portrayal
The players choose a colour they like. Each player has two "Eric" of the same colour. The character comes with colours like yellow, blue, green and red.

Game world graphics
The game's style is borrowed from the cartoon, which has the same design as Eric, Eric's children and the same people surrounding Eric. The game tries to intertwine the effects of stress with real life.

Sound/Music
As it is a card game there is no background music. During the game, players move their characters around. However, each player does not discuss with other players.

Storyline
This game shows how different situations can cause people to feel stressful; for example, events told from the first person such as: "Son Brain swallows his toy car during breakfast." or "Alarm clock doesn't work!" The game also depicts happier events:" Son Brian gets the role as a sheep in the school play." The game tells the story of Eric's stressful life.

[48] http://www.dailygames.com/games/stressed-eric.html

The Dragon, Cancer[49]

That Dragon, Cancer is created by Ryan and Amy Green. This game is based on their experience of looking after their son who had cancer and was given only a short time to live. The game highlights the difficult situations and problems from the parents' perspective and the ways to deal with them.

Game play

The game is played from third-person perspective to enable the users to see the abstracted scenes. The players can learn to look after children with cancer and to face the problems that arise due to the situation.

Avatar portrayal

There is no character or avatar for the players to choose. The patient is called Joel and the other characters in the game are his parents, his toys and some animals which he plays with.

Game world graphics

The game denotes Joel's life, using art to interact with characters. The games scenes are realistic, showing real life objects such as tables, sofas and other items which occur inside the house. It also includes the actual cards, letters and photos from the time Ryan had cancer. The game graphics try to immerse the user in the virtual world and 3D design. Its naturally colourful palate and design help the player feel they are actually in the game's world.

Sound/Music

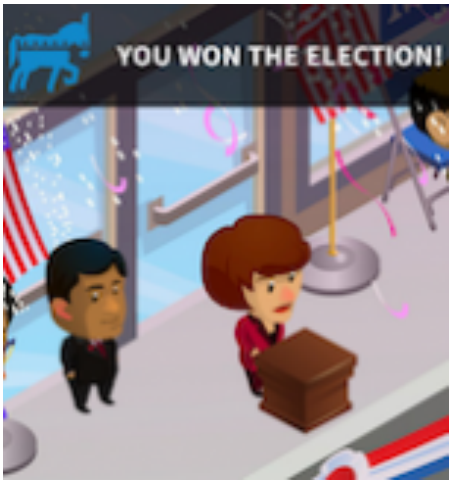
The background music helps shape the virtual world, such as the sound of the river, ducks and dog and also the voices of family members, including Ryan, Amy and others via their voicemails. The game displays the actual problems of this family, and the sound of actual conversations make it seem more real and increases the intimacy between the player and the subjects of the game.

Storyline

This is the actual story about the Green family and their process of battling cancer. This game shows how the family faced their problems and gives the players the virtual responsibility of looking after Joel who has cancer.

[49] http://www.thatdragoncancer.com/#home

Win the White House[50]



This game is designed for children ranging from 4-12 years old, inspired by the US presidential campaigns. The game was introduced in 2012, and was revamped in 2016 for the recent presidential election. The game is supported by the Hearst Foundations and has nearly 2.8 million players. The purpose of this game is for teachers and students to learn about civic issues.

Game play

The players need to use strategies to get funding, attract poll voters, organize an adverting campaign, etc. There are three stages in the game: Character, Issues, and Campaign Kit. The players choose their character, and there are different civic issues which need to be addressed such as global cooperation, federal funding for education, etc.

Avatar portrayal

This game has different styles of characters for the players to choose, such as gender, hair style, skin colour and name.

Game world graphics

The design includes the simple cartoon style of character, combined with the actual work places, such as the parliament centre.

Sound/Music

The background music is Happy Floating with competition sounds, also including the Crowd, Cheer, Clap, and Scream sound effects.

Storyline

The story raises civic issue awareness through the running of presidential campaigns. This game also highlights the democratic values.

[50] https://www.icivics.org/games/win-white-house

Zombie Castaways[51]

Zombie Castaways comprises of different types of games, including shooting, racing, etc. The atmosphere of *Zombie Castaways* is evil and horrifying. It uses a funny character to explore an island. The objective is to help the zombie become a human. This game available in 15 different languages and has 70 million players around the world.

Game play

This game is about helping a zombie become human. The zombie needs to build a town on the island. The zombie also can travel to different islands to find treasures.

Avatar portrayal

The avatar is a funny and evil zombie aiming to build up the island.

Game world graphics

The avatar is designed in a funny and evil style. The background of the island includes the trees, flowers, houses and different tools. Player be able to build up their own style of house, garden and so on.

Sound/Music

The background music depends on the action, such as cutting weeds. The zombie also makes strange noises.

Storyline

The zombie is not always evil; there is a friendly zombie who falls in love with a girl. This game is about helping the zombie become human.

[51] http://vizor-interactive.com/en/projects/zombiecastaways/

Appendix C: Game analysis by Category

Name of Game	Health	Education	Social	Genre	Platform
Aviation Empire	0	1 The story is about KML and teaches a user how to manage their airline.	1 A user can share their usage statistics via social media and compare high scores with friends.	Strategy	Mobile
Backpacker	0	1 Shows the problems you might face when back packing and how to deal with problems when you travel.	1 As a card game a player needs at least one more player to join. During the game the player needs to think about other people's strategies and work together or be independent.	Card game/ Strategy	Card game
Cancer Game	0.5 The message this game aims to deliver is how to live well.	1 The game's levels are comprised of different body parts and show the user how to look after each organ	0	Adventure	Online
Cortex Challenge	1 This is a brain training game.	0.5 This game helps train a player's brain but doesn't give strategies explaining how a player could improve their cognition.	1 In this game at least two players are needed. During the game every player tries to answer questions in order to get points.	Card/ Puzzle/Quiz	Card game
Elude	0.5 This game shows the issues faced by people with mental problems.	1 Gives greater understanding about the causes of depression.	0	Adventure	Online
Endgame:	0	1	1	Simulation	

Eurasia		This shows the story of the Syria war and how to fight in the war.	A news game linked with the social media to explore the issues experienced by the people in Syria		Online/ Mobile/ Tablet
Fugue	1 During the game the player explores their personality and solves problems.	0.5 The game helps a user to explore themselves and express their thinking but does not teach them how to deal with problems they encounter.	0	Adventure	Online
Homeland Guantanamos	0	1 This game is an advocate for human rights.	0.5 This game displays the offline community's events to the user.	Simulation	Online
Ice Flows	0	1 The game delivers information on climate change.	0	Adventure	Online/ Tablet
Inside the Haiti Earthquake	0	1 This is a portrayal of a real story about the earthquake in Haiti.	0.5 This game is not linked to any social network, but there is multimedia content, including films and videos, which show the story's issues.	Simulation	Online
Let the Cat in	0	0.5 This game helps people rethink the problems faced by stressed animals.	1 The game can be played on different platforms and is also linked to social media. It allows competition with other players.	Puzzle	Online/ Mobile/ Tablet
Pokémon Go	1	0.5	0.5		Mobile

	Engages with people, encouraging them to go out, walk around and visit new places.	It shows the stories and history of different places.	In this game a player can compete with other players but there is no community within the game. Also, it does not connect with a social media platform, unless a player prints their screen and posts it on their own social media to show the creatures that they have captured.	Adventure/ Sport	
ReachOut Orb	1 Improves the user's psychological wellbeing.	1 Encourages students to be more positive and face difficult situations in their life.	0	Adventure	Online/ Tablet
Re-Mission	1 Gives a player a positive way to face their problems and fight cancer.	1 This game shows different types of cancer and the treatments used, along with its effect on the body.	0	Shooting	Online/ Mobile
Sea Hero Quest	1 Helps improve people's navigational skills.	0	0.5 Users can share their score on their social media account, but does not include its own community within the game.	Adventure	Mobile
SideKick Cycle	0	0.5 The game gives an insight into impoverished communities.	0.5 This game engages people to play the game, hoping to convince people to donate a bike to the cause.	Racing	Online/ Tablet

Stressed Eric	0.5 This game shows players about the effects of stress on the life of Eric.	1 This game explains to the user about stress, but doesn't offer advice about how a user could face stressful situations in their own life.	1 The game is for up to 2 players.	Board/Role Playing Game(RPG)	Board
That Dragon, Cancer	1 How to face the problems posed looking after a person who has cancer.	1 Sharing experience with others about looking after a child who had cancer with others.	0	Adventure	Online/ Tablet
Win the White House	0.5 The game addresses questions on different issues, including global warming and education. Some issues also convey knowledge on health issues.	1 In this game, the user must run a successful presidential campaign. Throughout this process, important country and worldwide problems are highlighted to the user.	0.5 The game shows a leader board, which displays everyone's score, but there is no online community where people can share their ideas.	Adventure	Online
Zombie Castaways	0	0.5 The game also shows how to build a village and learn to become human.	1 This game is linked with different social media.	Simulation	Online/ Mobile/ Tablet

*1: Strongly agreed, 0.5: Partly agreed, 0: Disagreed

Appendix D: Game analysis by Content

Name of Game	Gameplay	Avatar portrayal	Game world graphics	Sound/Music	Storyline	Total Score
Aviation Empire	8 The game play is linked with social media and a real life map. It is a strategy game which allows players to operate an airline.	7 The game uses the players' Facebook profile picture as their character's picture.	8 The graphics create a 3D world, which contains airplanes, flags, staff, etc.	6 The background sounds adopts a sound of a real life airport with airplanes taking off and landing.	7 The game shows how airlines works, and tells the history of the KLM from 1919.	**36**
Backpacker	8 Players receive cards which reflect the good or bad things a person may experience whilst travelling, which allows them to learn to deal with the problems they encounter.	0 Players are unable to choose an avatar for their character.	9 The card design is very simple and easy to understand. The cards display graphics representing an event, except for the country cards, which show the real images	3 There is no background music, but players need to talk to each other when they play.	6 The gameplay follows many different possible stories of people travelling to different countries and the problems that may arise.	**26**
Cancer Game	5 There are different roles for players to play within the game. However, the target of each level of the game can be confusing sometimes.	2 There are different characters for the players to choose from, but the players cannot alter the details.	7 Designed to look like a factory in a cartoon style.	6 Adopts noises from real factories such as running machines to make the game closer to the actual environment.	7 There are five levels which show different stories of the body organs. The main story is about how to live well and healthy	**27**
	7	0	8	4	4	**23**

Cortex Challenge	The players must answer the questions posed by the card before the others do and physically slam their hand onto the card first.	Players are unable to choose an avatar for their character.	The game's graphics are quite simple. There are also cards which the player must touch to guess the object.	There is no background music, but during the game players need to speak and answer the questions to win the game.	During this game the players gain their critical thinking and memorizing skills	
Elude	6 Easy to play, but it is difficult to know which is the right direction.	3 The players cannot choose the avatar, but the game illustrates how a depressed individual looks like	8 Game design shows different moods of the character which carries different meanings.	6 Background music adopts the sound of the actual wind, sighing and walking sounds.	6 This game focuses on depressed people, but does not offer a solution in the game; it helps to give a basic understand of those with depression.	**29**
Endgame: Eurasia	5 The game is very complicated to play.	3 There is no avatar to choose, but there are different symbols for different cards.	6 The game involves different cards with different symbols.	4 Its music increases according to the fear experienced by the players.	9 This is a game about the current war in Syria.	**27**
Fugue	6 A user can choose their own persona which has a unique meaning and power to use.	5 A player can choose their persona, whose looks reflect their personality.	6 The design style mimics the Greek mythological style. In the game the people are animated with a cartoon style.	4 Light background music is played.	5 A player faces different problems in the story line and can choose to act in a kind or evil way as shown by different Tarot cards to solve the problem.	**26**

Homeland Guantanamos	5 Click on the mouse to go to the different rooms. The game illustrates the scenario that happened in reality.	4 The main character is Boubacar Bah. The game is about his story.	8 It is a 3D design and shows the actual facility.	7 Background music with people describing the facilities and their stories.	9 This game is an actual story about human rights.	**33**
Ice Flows	7 The game is easy to understand and to control, even though there are different levels to control the snow and temperature.	2 There is no avatar for players to choose but there are different characters in game.	8 Cartoon ice land environment using simple icons.	6 Light background music and voice to remind the players of the remaining time.	6 This game shows the story of the climate change, but it does not offer solutions for this issues.	**29**
Inside the Haiti Earthquake	5 The players choose a role to play. This is more about exploring the actual problem that the people in Haiti are facing.	5 The players cannot customized the avatar but there are three different roles with actual people's photos.	9 This game is a documentary game which shows real footage of the tragedy.	8 The game uses actual voices to describe the earthquake.	9 The game involves 3 different storylines. It shows real life situations and how people face them.	**36**
Let the Cat in	8 The game is easy to play and has guides for a few levels.	4 The player cannot choose an avatar. The main character is a cat who is going to an elderly lady's house.	8 Designed as a cartoon with real furniture.	6 Background music adopts the sound of the cat and rain.	5 The game depicts the stress experienced by a cat, and helps the audience to rethink the issues about stressed animals.	**31**

Pokémon Go	9 The game links the virtual environment to the reality, allowing users to catch, hatch and evolve virtual Pokémon creatures in real-world locations via GPS. Players need to walk around to find Pokémon. This game combines virtual gameplay with real life activities.	9 A player can choose their own gender, hair, skin colour etc. The can also choose their own equipment, such as a bag and clothes.	9 The game combines a virtual environment with actual street views.	5 When players walk around they can hear the sound of their footsteps. Different Pokémons have different sounds.	6 Players are able to explore the real world and learn the history behind real buildings at the same time.	**38**
ReachOut Orb	7 The game is designed to help a child's health and education. During the game, their mental fitness and wellbeing can be improved.	7 The student chooses their own avatar to reflect their own personality.	7 The design is soft in colour and encourages the child to explore the world with a cartoon style.	5 The background music tries to get children more involved in the game. Every step is accompanied by a sound as well as moving sound effects.	7 The story tells the children about different personalities and how to face their problems.	**33**

Re-Mission	7 There are different tools for players to choose from to kill the cancer cells. Different types of cancer have different treatments.	4 The players cannot choose their own character, however they can choose where to fight the cancer cells within the human body.	7 The graphics depicted the cancer cells as evil but not in a scary way.	6 Sound effects are similar to other shooting games. The background music enhances the dark atmosphere such that players become more focused on shooting the cancer.	7 This game educates the players on different forms of cancer and their respective treatments.	**31**
Sea Hero Quest	7 Consists of different targets for the players	5 Before the game it asks for personal information; there are not many options at the beginning of the game until the players win each mini-game	8 The design is simple and quick to understand. The symbols link the user to the real world, such as the sea, Iceland etc.	7 The background music is atmospheric and adds to the authenticity of the experience. For example, the driving of the boat in the game is accompanied by a sound effect.	8 The game highlights the problems dementia sufferers have with navigation, and aims to train the user's brain in this respect. Non dementia sufferers are encouraged to play too.	**35**
SideKick Cycle	7 The game is very easy to play; it is similar to Super Mario.	8 The players can customize their own avatar, such as gender, skin colour etc.	8 The game has a simple design with villages built into the background.	5 The background music adopts the sounds of the cycling.	5 The game is more of an advertising game such that it encourages people to play to raise money for an organization.	**33**

Stressed Eric	4 The player's path is determined by chance. Every player starts at 300 stress points and each player will face different problems. When the situation is more stressful, their stress point increases.	3 The players are able to choose a differently coloured counter.	6 This design is similar to the cartoon of Stressed Eric.	2 There is no background music; the players do not need to discuss with other players during the game.	5 The game illustrates how people can become stressed.	**20**
That Dragon, Cancer	5 There is a lot of animation, but it does not give any hints on how to play the game, thus sometimes it will confuse the player. However, it does convey the message of the game.	3 The players cannot choose an avatar. But there are different characters portrayed within the game, such as animals or toys.	8 The background animation reflects the real world, such as rivers and parks. This is combined with real world photos within the child's house.	8 The background sound effects include the sound of the wind, river and animal noises. It also has actual recordings from the cancer patient's mother, father and brother. The voices display a full range of emotions, such as crying and laughing.	9 It is a good story about the actual parents looking after their sick child. This game shows the parents' emotions and how they coped with the problems of having a sick child.	**33**

Win the White House	7 First, players choose their own avatar. Then, they answer questions to proceed to the next round. The final stage involves setting up their own advertising campaign.	9 The players customize their own character and are able to create their own name.	8 Simple cartoon design. Uses real-world setting.	6 Cheerful background music and some cheering and clapping sounds.	7 Illustrates the presidential campaigns and links it with the actual civic questions.	**37**
Zombie Castaways	5 The game is about building on an island. It is very similar to other games like Lego.	3 Players are not able to choose the avatar, but the game portraits the zombie as an evil and funny character.	7 The game design has an evil and funny style with actual things such as trees, a house and tools.	6 The voice of the zombie is very funny and has different sounds for different actions.	5 The game shows how to help the zombie to become human.	**26**
Total Score	**68**	**43**	**76**	**50**	**64**	

*0-10; 0= Poor, 10=Excellent

Appendix E: Metric table based on framework element and game content

Components		Gameplay			Avatar Portrayal	Game world graphics	Sound/ Music	Storyline
	Parameter / Question Code	GP_Gamesupport : Game support with more than one purpose	GP_Message: Game feedback, message and information links with the game purpose	GP_Collaboration: Game combines with other platforms	AP_Avatar: Avatars give the meaning message	GW_Realism: Game world shows a realistic environment	SM_Background music: Including the voice and sound supports the game with more meaning	SL_Compelling: Storyline keeps the player engaged in the game
Health	H_Education: Education Strengthen Health component	Educates the players to increase their knowledge of health	Coveys messages/ information as part of the education components to achieve changes in health behavior	Collaborates with the education components to help the players to understand the health issues	Game gives the message for changing health behavior through avatar characteristics	Game world shows real life or real situations involving the health issues	Background voice gives meaningful health messages	Game story educates the player and change health behavior
	H_Social: Social Supports Health component	Social media as an online community to support health	Game's message/ information links with community to support health	Game links with social support to discuss player's health issues	Avatars engage other players, as group effect attempting to change health behaviors	Game world with real community support to change health behaviors	Game can share the players' voice to support health	Game story with the social components to keep the players engaged
	H_Engagement: Engagement improves Health component	Game as a platform to engage players and improve their health	Community encouraging players to discuss the game's message /information and improve player health	Game uses engagement to improve health	Using avatars to engage communities and improve health	Game world engages people with health behaviors	Background music can encourage players to improve their health	Game story is able to encourage players to improve the health
Education	E_Social: Social component encourages	Social elements in the game to support the community to	The game's message/ information links with communities	Game collaboration with social media to increase the size	Using the avatars links with social platforms to	Game's world presented to real life and using the social community	Social voice encourages players to get knowledge	The storyline is entertaining enough to keep the player interested in the

	Education component	spread the knowledge	to encourage player education	of communities to encourage education components	encourage player education	to inform education		game, using plot twists, conflict and interesting characterization
	E_Engagement: Engagement informs education component	The game shows multiple ways to solve the problems, and also involve other players' views	Game's message/ information can be discussed with other players	Game engages players to inform educate component	Avatars can be social components to engage users and inform education	Game world gives information that would be useful in real life	Background voice/ music can encourage players to get knowledge	Game story can engage players, informing the education components
Social	S_Engagement: Engagement produces social component	Social marketing with game to raise awareness	Game's message/ information encourages the player to produce social components	The game provides a chat room, game community, email/messaging, "buddy list" or link to a social networking website	Avatar portrayal to engage player produces social components	Game word encourages similar types of player to produce communities	Background music/sound is able to encourage players to produce communities	Game story engages players, increasing the size of the person's community

Appendix F: Metric instrument using GQM method

Goal			Questions	Metrics	
				G: Metric applied to the game	E: Metric applied to the evaluate of components
Health	H1: To evaluate how education strengthens the Health component	Gameplay	How does the game support educating the player and increasing their knowledge of health?	G1: While playing, I gained new knowledge from the game's message/information section about how to improve health.	E1: I believe education in game is important to strengthen health knowledge. For example, games can educate players about understanding their health.
			How does the games message/information convey the health element?	G2: *The game's message/ information does not give enough information about health issues.	
			How does the game link up with the education element to give the player knowledge of health?	G3: *While playing, I don't feel the game educated the player about the health issues.	
		Avatar	How does the game give the message for changing health behaviour through avatar characteristics?	G4: Adjusting the characteristics of the game's avatars could change the players' health behaviour.	
		Game World Graphics	How accurately does the game environment reflect situations in the real world?	G5: I felt the game was related to real life situations which involve health issues.	
				G6: * I don't think building a realistic environment is necessary to help understand the health issues the game is trying to indicate.	
		Sound / Music	How does the game give its message through the background music and sound?	G7: The game's background music/sound got in the way of understanding the health issues.	
				G8: The game's background narrator or commentator gave supporting information about the health issues.	
		Storyline	How does the game story help the player change their health behaviour?	G9: After I play through the game's story, I understand more about health issues.	
				G10: * After I play through the game I do not think I will change my health behaviour.	
	H2: Evaluate how social	Gameplay	How does the game link to social media to support health?	G11: Playing the game in combination with social media platforms can help	E2: I believe social platforms can

	media supports the Health component			support people with their health issues.	support health (for example, communities can support health by providing information or talking therapy).
				G12: * I don't think using the online community will be able to support people with their health issues.	
			How does the game message/information link with social communities to support health?	G13: The game allowed me to link with communities to discuss the health issues.	
			How does the game collaborate with the social element support to improve player's health?	G14: *The game does not facilitate the with community members to discuss the health issues.	
		Avatar	How does the game use the group effect to change health behaviour?	G15:Using an avatar whilst playing the game helps to bring me closer to the community.	
				G16: I feel that by using my avatar within the community helps me to change my health behaviours.	
		Game World Graphics	How does the game world bring in real communities?	G17: I think the game world encourages players to seek out real-world communities to find support for their health issues.	
		Sound / Music	How does the game allow the player to share their health experience vocally?	G18: In the game, I was allowed speak to other people about health issues.	
		Storyline	How does the game story keep the player invested in the game?	G19: I felt the game story made me interested in finding out more about health.	
				G20: * Whilst playing the game, I don't focus on the game story.	
	H3: Evaluate engagement improve Health component	Gameplay	How does the game act as a platform to engage players and improve their health?	G21:I think the social aspects of the platform help to engage with other people to improve health.	E3: I believe engagement improves the health component, such as engaging the player deeply so they can understand their health.
			How does the community engage the player to discuss the message/ information in the game and improve their health?	G22: *The platform did not allow engagement with the community in order to improve health.	
			How does the game engage people to improve their health?	G23: *I did not find the game engaging enough to improve healthy behaviour.	
		Avatar	How do the game avatars engage	G24: While playing, I found the game elements (avatars,	

			communities and improve health?	graphics and music) can change our behaviours.	
				G25: While playing the game I found the game elements (avatars, graphics and music) can engage people with the health issues.	
		Game World Graphics	How does the game world engage people with health behaviour?	G26: * Whilst playing the game, the game world encourages people to engage on health issues.	
		Sound/ Music	What types of background music/ sounds can engage players to improve their health?	G27: *when playing the game, the background music does not help engage people in the health issues.	
		Storyline	What type of game story can engage player to improve their health?	G28: While playing, I felt motivated by the game story to improve my health behaviour.	
Education	E1: Evaluate Social component encourages Education component	Gameplay	How does the game spread the knowledge via the community support?	G29: I found the social platform associated with the game helped me discuss issues with the communities.	E4: I believe social media encourages education, such as communities bringing discussion of different issues.
			How does the game provide the message/information connected with communities to educate players?	G30: * I don't think the game provides new things to learn.	
			How do social media lead to online communities to increase the size of people's community?	G31: I felt the social platform associated with the game increased the size of communities through which I can discuss the issues.	
		Avatar	How does the game use the avatars connected with the social platform to encourage players to learn?	G32: I found using an avatars helped me connect with social media.	
				G33: I found using the asocial media platform associated with the game enabled me to get more information.	
		Game World Graphics	How does the game connect with real life and involve social communities?	G34: I found that the game world represents real life issues.	
				G35: I found that the game world involving social communities allowed me to be informed about the issues.	
		Sound / Music	How does the game use background music and sound to	G36: I think the background music and sound helped be related to the education.	

			encourage players to develop new knowledge?	G37: The background narrator or commentator supplying more information.	
		Storyline	How does the game story make it more entertaining, to keep the player invested?	G38: I felt the game used plot twists, conflict and interesting characterization to make it more interesting.	
	E2: To Evaluation engagement informs education component	Gameplay	How does the game support multiple ways to solve the problems?	G39: I found the game shows different ways to handle real life issues.	E5: I think engagement can inform education. For example, to engage people to deeply understand the specific issues.
			How does the game give the message/ information to bring people to discuss the issues?	G40: The game's message is interesting enough to discuss with other people.	
			How does the gameplay engage people in terms of the knowledge?	G41: * I don't think the gameplay can engage people to get new knowledge.	
		Avatar	How does the avatar, as a social element, engage and educate players?	G42: I found the avatar can motivate other players to discuss issues.	
		Game World Graphics	Does the game world provide useful knowledge that links with real world?	G43: The game world graphics and background music give new knowledge about the real world.	
		Sound / Music	How does the game use background music/sound to motivate people to get new knowledge?	G44: *I don't feel the background music and sound will help motivate people to obtain new knowledge.	
		Storyline	How does the storyline engage players and increase the size of players' communities?	G45: After I play a game, I would discuss the issues with other players.	
				G46: After I played a game, through discussing the issues with other players, I made friends.	
Social	S1: Evaluate engagement produces social component	Gameplay	How does the game apply social marketing knowledge to support game to raise awareness?	G47: I found the game can raise social awareness of the issues.	E6: I believe engagement promotes social components. For example, by encouraging players to become involved in communities.
				G48: I think social is very important in game's element	
				G49: * I don't think the game's social component help raise awareness.	
			Do the game message/information be able to encourage players to become involved in communities?	G50: I think the game's message and information lead to people becoming involved in the community.	
			How does the game encourage players to	G51: * I don't feel the game's t social media	

			become deeply involved in communities which link with social media?	encouraged players to get deeply involved with each other	
		Avatar	How is the avatar able to encourage players to communicate?	G52: The avatar and game world helped me to connect with other players of similar styles of avatars.	
		Game World Graphics	How does the game world help players to increase their communities' size?	G53: * I don't feel the game world helped players grow the size of the communities.	
		Sound/ Music	How does the game apply background music and sound to engage people?	G54: I think the background music and sound helped to link with other players in the game.	
		Storyline	How can the game story increase the size of communities?	G55: I found the game story helped me to discuss similar interesting issues with other players.	
				G56: I found that discussing similar interesting issue with players helped increase the size of the community.	

Appendix G: The piloting survey for games for dementia carer

The main goal of this research is to use the game as an online platform to perceive education, health and social element to support dementia carers. The validation will have involved with piloting the metrics with academic researchers. The purpose of the validation to uncover the potential flaws and suggested to be conducted before the formal experiment. The questions with three parts such as game choice, time issues and questionnaire issues. There are the sample of survey questionnaire for formal experiment to test with the participants who are game professional (game designer / game developer / game researcher) will provide. Those games were chosen that related to games for change especially for health and education as follow:

- Re-Mission[52]: The game is designed to aid a young patient's psychological health which is made for people who had cancer and their families to understand the positive ways to fight cancer with different treatments.
- Cancer game [53]: In this game display the symptoms and causes of cancer, and gives knowledge of health behaviours.
- Sea Hero Quest[54]: This is an Alzheimer's Research game in order to helping global research into dementia.
- Life in a Spin[55]: The game is practical support and advice for young adult carers. Game balance caring with your everyday.
- The Dysphagia Game[56]: This game was developed with the NHS. This game gives knowledge of dysphagia.
- NHS Nene CCG[57]: In this game shows the NHS services for different health situations to help people and carers when they are unwell.

Game Choice

1. Do you think these games are suitable to be testing to the game professionals?
2. Do you think testing using games are able to see whether the metrics are reliably to game professionals?
3. Do you have any comments about the games?

Timing issues

1. Do you think play each games for five minutes is enough time to understand the game?
2. Do you think game professionals can complete the test in one hour?
3. Do you think this study will take too long for game professionals?
4. Do you have any comments of the time?

[52] http://www.re-mission2.org/games/. *Six games to fight cancer.,* ReMission2.
[53] http://veevia.com/playgame/cancergame.html. *Cancer game.,*Cafa/ Experimental multimedia studio.
[54] http://www.seaheroquest.com/en. Sea Hero Quest.
[55] http://lifeinaspin.org/scenarios/school.
[56] http://mynutilis.co.uk/game. *The Dysphagia game.,* Nutricia.
[57] http://www.neneccg.nhs.uk/play-our-nhs-game/ *Nene.,* NHS.

Questionnaire issues

1. Do you think formal experiment questions are too much for game professionals ?
2. Do you think formal experiment questions are not enough to get metric data ?
3. Do you think the formal experiment questions are simple, easy to read and understand?
4. Do you have any confuse of any question? Any example?
5. Do you think the survey questions can elicit a deep understanding of the participants' (game professionals and carers of people with dementia) point of view?
6. Do you think the survey questions can elicit a deep understanding of dementia carers needs?
7. Do you have any comments of the formal experiment questions?

Appendix H: Survey questionnaire for experiences game Professionals

Survey Questionnaire Part1: Metric applied to the games

The survey comprises six games and respective questionnaires. Participant will be asked to play each game for 5 minutes and then complete the respective questionnaire, which also takes about 5 minutes to complete.

Instructions:
Please evaluate the following statement about the game you just played and choose how much you agree/disagree with each of the item.

Criteria:

	Definition
"Strongly Disagree"	The item shows too little or is non-existent in the game
"Disagree"	The item shows a minor portrayal in the game
"Neither"	The item shows an undecided view about whether to agree nor disagree
"Agree"	The item shows an satisfactory level in the game
"Strongly Agree"	The item shows an outstanding level in the game

Health

To evaluate how education strengthens the **Health** component

Metric applied to the game	**Strongly Disagree**	**Disagree**	**Neither**	**Agree**	**Strongly Agree**
G1: While playing, I gained new knowledge from the game's message/information section about how to improve my health.					
G2: *The game's message/information does not give enough information about health issues.					
G3: *While playing, I don't feel the game educated the player about the health issues.					
G4: Adjusting the characteristics of the game's avatars could change the players' health behaviour.					
G5: I felt the game was related to real life situations which involve health issues.					
G6: * I don't think building a realistic environment is necessary to help understand the health issues the game is trying to indicate.					
G7: The game's background music/sound got in the way of understanding the health issues.					
G8: The game's background narrator or commentator gave supporting information about the health issues.					
G9: After I play through the game's story, I understand more about health issues.					
G10: * After I play through the game I do not think I will change my health behaviour.					

Evaluate how social media supports the **Health** component

Metric applied to the game	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
G11:Playing the game in combination with social media platforms can help support people with their health issues.					
G12: * I don't think using the online community will be able to support people with their health issues.					
G13: The game allowed me to link with communities to discuss the health issues.					
G14: *The game does not facilitate the with community members to discuss the health issues.					
G15:Using an avatar whilst playing the game helps to bring me closer to the community.					
G16: I feel that by using my avatar within the community helps me to change my health behaviours.					
G17: I think the game world encourages players to seek out real-world communities to find support for their health issues.					
G18: In the game, I was allowed speak to other people about health issues.					
G19: I felt the game story made me interested in finding out more about health.					
G20: * Whilst playing the game, I don't focus on the game story.					

Evaluate engagement improve **Health** component

Metric applied to the game	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
G21:I think the social aspects of the platform help to engage with other people to improve my health.					
G22: *The platform did not allow engagement with the community in order to improve health.					
G23: *I did not find the game engaging enough to improve healthy behaviour.					
G24: While playing, I found the game elements (avatars, graphics and music) can change our behaviours.					
G25: While playing the game I found the game elements (avatars, graphics and music) can engage people with the health issues.					
G26: Whilst playing the game, the game world encourages people to engage on health issues.					
G27: *when playing the game, the background music does not help engage people in the health issues.					

G28: While playing, I felt motivated by the game story to improve my health behaviour.					

Education

Evaluate Social element encourages **Education** component

Metric applied to the game	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
G29: I found the social platform associated with the game helped me discuss issues with the communities.					
G30: * I don't think the game provides new things to learn.					
G31: I felt the social platform associated with the game increased the size of communities through which I can discuss the issues.					
G32: I found using an avatars helped me connect with social media.					
G33: I found using the asocial media platform associated with the game enabled me to get more information.					
G34: I found that the game world represents real life issues.					
G35: I found that the game world involving social communities allowed me to be informed about the issues.					
G36: I think the background music and sound helped be related to the education.					
G37: The background narrator or commentator supplying more information.					
G38: I felt the game used plot twists, conflict and interesting characterization to make it more interesting.					

To Evaluate engagement informs **Education** component

Metric applied to the game	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
G39: I found the game shows different ways to handle real life issues.					
G40: The game's message is interesting enough to discuss with other people.					
G41: * I don't think the gameplay can engage people to get new knowledge.					
G42: I found the avatar can motivate other players to discuss issues.					
G43: The game world graphics and background music give new knowledge about the real world.					

G44: *I don’t feel the background music and sound will help motivate people to obtain new knowledge.					
G45: After I play a game, I would discuss the issues with other players.					
G46: After I played a game, through discussing the issues with other players, I made friends.					

Social

Evaluate engagement produces **Social** component

Metric applied to the game	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
G47: I found the game can raise social awareness of the issues.					
G48: I think social is very important in game's element.					
G49: * I don't think the game’s social component help raise awareness.					
G50: I think the game’s message and information lead to people becoming involved in the community.					
G51: * I don’t feel the game’s social media platform encouraged players to become closer to each other.					
G52: The avatar and game world helped me to connect with other players of similar styles of avatars.					
G53: * I don’t feel the game world helped players grow the size of the communities.					
G54: I think the background music and sound helped to link with other players in the game.					
G55: I found the game story helped me to discuss similar interesting issues with other players.					
G56: I found that discussing similar interesting issue with players helped increase the size of the communities.					

* Reverse-worded questions

Survey Questionnaire Part2: Metric applied to the evaluate of framework components

The survey base on the framework elements including three components which is dementia carers need: Health, Educate and Social. Games for change platforms: Social marketing, Social media and Game. In additional, Engagement are main elements in the framework. The purpose of this survey is to collect feedback about how to address those components form framework in actual game.

Instructions:
Please evaluate the following statement about the game you just played and choose how much you agree/disagree with each of the item.

Criteria:

Rating	Definition
"Strongly Disagree"	The item shows too little or is non-existent in the game
"Disagree"	The item shows a minor portrayal in the game
"Neither"	The item shows an undecided view about whether to agree nor disagree
"Agree"	The item shows an satisfactory level in the game
"Strongly Agree"	The item shows an outstanding level in the game

Health

Metric applied to the evaluate of element	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
E1: I believe education in games is important to strengthen health knowledge, by helping players to understand their health issues.					
E2: I believe social platforms can support health, such as providing information or talking therapy through communities.					
E3: I believe engagement can improve health, by allowing the players to understand their health issues, what they need to do to address them, and why.					

Education

Metric applied to the evaluate of element	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
E4: I believe social media encourages education, such as by communities bringing discussions of different issues.					
E5: I think engagement can help education, by helping people to deeply understand their specific issues.					

Social

Metric applied to the evaluate of element	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
E6: I believe engagement promotes social interaction, such as by encouraging players to become involved in the communities.					

Appendix I: Exploratory experiment I

Output of the Normality tests and Mann Whitney Test for Framework element and components

Tests of Normality[c]

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Health_Education	.367	5	.026	.684	5	.006
Health_Social	.367	5	.026	.684	5	.006
Health_Engagement	.231	5	.200*	.881	5	.314
Education_Social	.473	5	.001	.552	5	.000
Education_Engagement	.473	5	.001	.552	5	.000

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction
c. Social_Engagement is constant. It has been omitted.

Mann-Whitney Test
Ranks

	Group	N	Mean Rank	Sum of Ranks
Health_Education	Participants	5	8.00	40.00
	Null	5	3.00	15.00
	Total	10		
Health_Social	Participants	5	8.00	40.00
	Null	5	3.00	15.00
	Total	10		
Health_Engagement	Participants	5	7.50	37.50
	Null	5	3.50	17.50
	Total	10		
Education_Social	Participants	5	8.00	40.00
	Null	5	3.00	15.00
	Total	10		
Education_Engagement	Participants	5	8.00	40.00
	Null	5	3.00	15.00
	Total	10		
Social_Engagement	Participants	5	8.00	40.00
	Null	5	3.00	15.00
	Total	10		

Test Statistics[a]

	Health_ Education	Health_ Social	Health_ Engagement	Education_ Social	Education_Engagement	Social_ Engagement
Mann-Whitney U	.000	.000	2.500	.000	.000	.000
Wilcoxon W	15.000	15.000	17.500	15.000	15.000	15.000
Z	-2.835	-2.835	-2.372	-2.887	-2.887	-3.000
Asymp. Sig. (2-tailed)	.005	.005	.018	.004	.004	.003

a. Grouping Variable: Group
b. Not corrected for ties.

Appendix J: Non-Parametric Means Test

Game 1 Re-Mission

Ranks

	Group	N	Mean Rank	Sum of Ranks
Health_Education	Null	5	6.00	30.00
	Participants	5	5.00	25.00
	Total	10		
Health_Social	Null	5	6.00	30.00
	Participants	5	5.00	25.00
	Total	10		
Health_Engagement	Null	5	5.00	25.00
	Participants	5	6.00	30.00
	Total	10		
Education_Social	Null	5	6.00	30.00
	Participants	5	5.00	25.00
	Total	10		
Education_Engagement	Null	5	5.00	25.00
	Participants	5	6.00	30.00
	Total	10		
Social_Engagement	Null	5	6.00	30.00
	Participants	5	5.00	25.00
	Total	10		

Test Statistics[a]

	Health_ Education	Health_ Social	Health_ Engagement	Education_ Social	Education_ Engagement	Social_ Engagement
Mann-Whitney U	10.000	10.000	10.000	10.000	10.000	10.000
Wilcoxon W	25.000	25.000	25.000	25.000	25.000	25.000
Z	-.559	-.557	-.557	-.557	-.557	-.557
Asymp. Sig. (2-tailed)	.576	.577	.577	.577	.577	.577
Exact Sig. [2*(1-tailed Sig.)]	.690[b]	.690[b]	.690[b]	.690[b]	.690[b]	.690[b]

a. Grouping Variable: Group
b. Not corrected for ties.

Game 2 Cancer Game

Ranks

	Group	N	Mean Rank	Sum of Ranks
Health_Education	Null	5	4.00	20.00
	Participant	5	7.00	35.00
	Total	10		
Health_Social	Null	5	6.00	30.00
	Participant	5	5.00	25.00
	Total	10		
Health_Engagement	Null	5	4.50	22.50
	Participant	5	6.50	32.50
	Total	10		
Education_Social	Null	5	5.00	25.00
	Participant	5	6.00	30.00
	Total	10		
Education_Engagement	Null	5	5.00	25.00
	Participant	5	6.00	30.00
	Total	10		
Social_Engagement	Null	5	5.00	25.00
	Participant	5	6.00	30.00
	Total	10		

Test Statistics[a]

	Health_Education	Health_Social	Health_Engagement	Education_Social	Education_Engagement	Social_Engagement
Mann-Whitney U	5.000	10.000	7.500	10.000	10.000	10.000
Wilcoxon W	20.000	25.000	22.500	25.000	25.000	25.000
Z	-1.671	-.557	-1.181	-.557	-.557	-.561
Asymp. Sig. (2-tailed)	.095	.577	.238	.577	.577	.575
Exact Sig. [2*(1-tailed Sig.)]	.151[b]	.690[b]	.310[b]	.690[b]	.690[b]	.690[b]

a. Grouping Variable: Group
b. Not corrected for ties.

Game 3 Sea Hero Quest

Ranks

	Group	N	Mean Rank	Sum of Ranks
Health_Education	Null	5	4.00	20.00
	Participant	5	7.00	35.00
	Total	10		
Health_Social	Null	5	6.50	32.50
	Participant	5	4.50	22.50
	Total	10		
Health_Engagement	Null	5	5.00	25.00
	Participant	5	6.00	30.00
	Total	10		
Education_Social	Null	5	6.00	30.00
	Participant	5	5.00	25.00
	Total	10		
Education_Engagement	Null	5	6.00	30.00
	Participant	5	5.00	25.00
	Total	10		
Social_Engagement	Null	5	6.00	30.00
	Participant	5	5.00	25.00
	Total	10		

Test Statistics[a]

	Health_ Education	Health_ Social	Health_ Engagement	Education_ Social	Education_ Engagement	Social_ Engagement
Mann-Whitney U	5.000	7.500	10.000	10.000	10.000	10.000
Wilcoxon W	20.000	22.500	25.000	25.000	25.000	25.000
Z	-1.671	-1.177	-.559	-.557	-.557	-.557
Asymp. Sig. (2-tailed)	.095	.239	.576	.577	.577	.577
Exact Sig. [2*(1-tailed Sig.)]	.151[b]	.310[b]	.690[b]	.690[b]	.690[b]	.690[b]

a. Grouping Variable: Group
b. Not corrected for ties.

Game 4 Life in a Spin

Ranks

	Group	N	Mean Rank	Sum of Ranks
Health_Education	Null	5	4.00	20.00
	Participant	5	7.00	35.00
	Total	10		
Health_Social	Null	5	6.00	30.00
	Participant	5	5.00	25.00
	Total	10		
Health_Engagement	Null	5	4.00	20.00
	Participant	5	7.00	35.00
	Total	10		
Education_Social	Null	5	5.00	25.00
	Participant	5	6.00	30.00
	Total	10		
Education_Engagement	Null	5	5.00	25.00
	Participant	5	6.00	30.00
	Total	10		
Social_Engagement	Null	5	5.00	25.00
	Participant	5	6.00	30.00
	Total	10		

Test Statistics[a]

	Health_ Education	Health_ Social	Health_ Engagement	Education_ Social	Education_ Engagement	Social_ Engagement
Mann-Whitney U	5.000	10.000	5.000	10.000	10.000	10.000
Wilcoxon W	20.000	25.000	20.000	25.000	25.000	25.000
Z	-1.677	-.557	-1.671	-.557	-.559	-.557
Asymp. Sig. (2-tailed)	.094	.577	.095	.577	.576	.577
Exact Sig. [2*(1-tailed Sig.)]	.151[b]	.690[b]	.151[b]	.690[b]	.690[b]	.690[b]

a. Grouping Variable: Group
b. Not corrected for ties.

Game 5 The Dysphagia Game

Ranks

	Group	N	Mean Rank	Sum of Ranks
Health_Education	Null	5	5.00	25.00
	Participant	5	6.00	30.00
	Total	10		
Health_Social	Null	5	5.50	27.50
	Participant	5	5.50	27.50
	Total	10		
Health_Engagement	Null	5	5.50	27.50
	Participant	5	5.50	27.50
	Total	10		
Education_Social	Null	5	6.00	30.00
	Participant	5	5.00	25.00
	Total	10		
Education_Engagement	Null	5	6.00	30.00
	Participant	5	5.00	25.00
	Total	10		
Social_Engagement	Null	5	5.00	25.00
	Participant	5	6.00	30.00
	Total	10		

Test Statistics[a]

	Health_ Education	Health_ Social	Health_ Engagement	Education_ Social	Education_ Engagement	Social_ Engagement
Mann-Whitney U	10.000	12.500	12.500	10.000	10.000	10.000
Wilcoxon W	25.000	27.500	27.500	25.000	25.000	25.000
Z	-.557	.000	.000	-.557	-.557	-.557
Asymp. Sig. (2-tailed)	.577	1.000	1.000	.577	.577	.577
Exact Sig. [2*(1-tailed Sig.)]	.690[b]	1.000[b]	1.000[b]	.690[b]	.690[b]	.690[b]

a. Grouping Variable: Group
b. Not corrected for ties.

Game 6 Brain Training Game Demonstration

Ranks

	Group	N	Mean Rank	Sum of Ranks
Health_Education	Null	5	7.00	35.00
	Participant	5	4.00	20.00
	Total	10		
Health_Social	Null	5	5.50	27.50
	Participant	5	5.50	27.50
	Total	10		
Health_Engagement	Null	5	6.00	30.00
	Participant	5	5.00	25.00
	Total	10		
Education_Social	Null	5	6.50	32.50
	Participant	5	4.50	22.50
	Total	10		
Education_Engagement	Null	5	6.00	30.00
	Participant	5	5.00	25.00
	Total	10		
Social_Engagement	Null	5	6.00	30.00
	Participant	5	5.00	25.00
	Total	10		

Test Statistics[a]

	Health_ Education	Health_ Social	Health_ Engagement	Education_ Social	Education_ Engagement	Social_ Engagement
Mann-Whitney U	5.000	12.500	10.000	7.500	10.000	10.000
Wilcoxon W	20.000	27.500	25.000	22.500	25.000	25.000
Z	-1.671	.000	-.559	-1.177	-.557	-.557
Asymp. Sig. (2-tailed)	.095	1.000	.576	.239	.577	.577
Exact Sig. [2*(1-tailed Sig.)]	.151[b]	1.000[b]	.690[b]	.310[b]	.690[b]	.690[b]

a. Grouping Variable: Group
b. Not corrected for ties.

Appendix K: Survey questionnaire for game professionals

Survey Questionnaire: Metric applied to the games

The survey comprises six games and respective questionnaires. Participant will be asked to play game for five minutes and then complete the respective questionnaire, which also takes about five minutes to complete.

Instructions:
Please evaluate the following statement about the game you just played and choose how much you agree/disagree with each of the item.

Criteria:

Rating	Definition
"Strongly Disagree"	The item shows too little or is non-existent in the game
"Disagree"	The item shows a minor portrayal in the game
"Neither"	The item shows an undecided view about whether to agree nor disagree
"Agree"	The item shows an satisfactory level in the game
"Strongly Agree"	The item shows an outstanding level in the game

Health

To evaluate how education strengthens the **Health** component

Metric applied to the game	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
G1: While playing, I gained new knowledge from the game's message/information section about how to improve my health.					
G2: *The game's message does not give enough information about health issues.					
G3: *While playing, I don't feel the game educated the player about the health issues.					
G4: Adjusting the characteristics of the game's avatars could change the players' health behaviours.					
G5: I felt the game was related to real-life situations which involve health issues.					
G6: * I don't think building a realistic environment is necessary to help understand the health issues the game is trying to indicate.					
G7: The game's background music/sound got in the way of understanding the health issues.					
G8: The game's background narrator or commentator gave supporting information about the health issues.					
G9: After I played through the game's story, I feel I understand more about the health issues.					
G10: * After I played through the game, I do not think I will change my health behaviour.					

Evaluate how social media supports the **Health** component

Metric applied to the game	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
G21: I think the social aspects of the platform help me to engage with other people, in order to improve my health.					
G22: *The platform did not allow engagement with the community in order to improve health.					
G23: *I did not find the game engaging enough to improve health behaviours.					
G24: While playing, I found that the game elements (avatars, graphics and music) can help change my health behaviours.					
G25: While playing the game I found the game elements (avatars, graphics and music) engage me with the health issues.					
G26: Whilst playing the game, I found the game world encouraged me to engage with the health issues.					
G27: *When playing the game, the background music did not help engage me in the health issues.					
G28: While playing, I felt motivated by the game's story to improve my health behaviours.					

Evaluate engagement improve **Health** component

Metric applied to the game	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
G11: I think playing the game in combination with social media platforms can help support people with their health issues.					
G12: * I don't think using the online community will be able to help support people with their health issues.					
G13: The game allowed me to link with communities to discuss the health issues.					
G14: *The game does not allow me to link with community members to discuss the health issues.					
G15: Using an avatar whilst playing the game helps to bring me closer to the community.					
G16: I feel that using my avatar within the community helps me to change my health behaviours.					
G17: I think the game world encourages players to seek out real-world communities to find support for their health issues.					
G18: In the game, I was able to speak to other people about health issues.					
G19: I felt the game story made me interested in finding out more about health issues.					

G20: * Whilst playing the game, I did not focus on the game story.					

Education

Evaluate Social element encourages **Education** element

Metric applied to the game	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
G29: I found the social platform associated with the game helped me to discuss the health issues with relevant communities.					
G30: * I don't think the game provides new things to learn.					
G31: I felt the social platform associated with the game helped increase the size of the communities through which I could discuss the issues.					
G32: I found using an avatar helped me to connect with other people through social media.					
G33: I found using the social media platform associated with the game enabled me to get more information about the health issues.					
G34: I think that the game world represents real life issues.					
G35: I found that involving the social communities in the game world allowed me to be more informed about the health issues.					
G36: I think the background music and sound helped improve my knowledge of the health issues.					
G37: I found the background narrator/commentator supplied additional information about the health issues.					
G38: I felt the game used plot twists, conflict and interesting characterization to make it more engaging.					

To Evaluate engagement informs **Education** element

Metric applied to the game	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
G39: I found the game showed different ways to handle real-life health issues.					
G40: I think the game's message is interesting enough to discuss with other people.					
G41: * I don't think the gameplay engaged me enough for me to gain new knowledge.					
G42: I found the avatar can motivate other players to discuss the health issues.					
G43: I found the game world graphics helped me to gain new knowledge about real-life health issues.					

G44: I think the game world graphics represent real health issues					
G45: I feel the game's background music and sound can help motivate people to obtain new knowledge about health issues					
G46: After I played the game, I would discuss the issues with other players.					
G47: After I played the game, I made friends through discussing the issues with other players.					

Social

Evaluate engagement produces **Social** component

Metric applied to the game	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
G48: I found the game can raise social awareness of the health issues.					
G49: I think the social component are very important in the game.					
G50: * I don't think the game's social component help raise awareness.					
G51: I think the game's message and information can lead to people becoming more involved in the communities.					
G52: * I don't feel the game's social media platform encouraged players to become closer to each other.					
G53: The avatar and game world helped me to connect with other players who had similar styles of avatars.					
G54: * I don't feel the game world would help players grow the size of the communities.					
G55: I think the game's background music and sound helped motivate players to link with each other.					
G56: I found the game's story helped me to discuss similar interesting issues with other players.					
G57: I found that discussing similar interesting issues with other players helped increase the size of the communities.					

* Reverse-worded questions

Appendix L: Exploratory experiment II - Normality tests

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
H_Education_GP_Support	.196	35	.002	.898	35	.004
H_Education_GP_Message	.266	35	.000	.876	35	.001
H_Education_GP_Collaboration	.187	35	.003	.915	35	.010
H_Education_AP	.183	35	.005	.913	35	.009
H_Education_GW	.314	35	.000	.811	35	.000
H_Education_GW2	.222	35	.000	.885	35	.002
H_Education_SM	.246	35	.000	.869	35	.001
H_Education_SM2	.174	35	.009	.884	35	.002
H_Education_SL	.179	35	.006	.913	35	.009
H_Education_SL2	.189	35	.003	.914	35	.010
H_Social_GP_Support	.333	35	.000	.820	35	.000
H_Social_GP_Support2	.337	35	.000	.815	35	.000
H_Social_GP_Messgae	.203	35	.001	.902	35	.005
H_Social_GP_Collaboration	.212	35	.000	.909	35	.007
H_Social_AP	.225	35	.000	.899	35	.004
H_Social_AP2	.219	35	.000	.902	35	.005
H_Social_GW	.224	35	.000	.894	35	.003
H_Social_SM	.248	35	.000	.870	35	.001
H_Social_SL	.203	35	.001	.907	35	.006
H_Social_SL2	.278	35	.000	.875	35	.001
H_Engagement_GP_Support	.204	35	.001	.898	35	.003
H_Engagement_GP_Message	.215	35	.000	.897	35	.003
H_Engagement_GP_Collaboration	.271	35	.000	.879	35	.001
H_Engagement_AP	.197	35	.001	.917	35	.012
H_Engagement_AP2	.257	35	.000	.889	35	.002
H_Engagement_GW	.329	35	.000	.807	35	.000
H_Engagement_SM	.265	35	.000	.881	35	.001
H_Engagement_SL	.254	35	.000	.885	35	.002
E_Social_GP_Support	.202	35	.001	.906	35	.006
E_Social_GP_Messgae	.248	35	.000	.887	35	.002
E_Social_GP_Collaboration	.183	35	.004	.911	35	.008
E_Social_AP	.220	35	.000	.913	35	.009
E_Social_AP2	.202	35	.001	.906	35	.006
E_Social_GW	.296	35	.000	.850	35	.000
E_Social_GW2	.189	35	.003	.915	35	.010
E_Social_SM	.237	35	.000	.900	35	.004
E_Social_SM2	.175	35	.008	.893	35	.003
E_Social_SL	.183	35	.005	.904	35	.005
E_Engagement_GP_Support	.280	35	.000	.865	35	.001
E_Engagement_GP_Messgae	.255	35	.000	.889	35	.002
E_Engagement_GP_Collaboration	.266	35	.000	.886	35	.002
E_Engagement_AP	.178	35	.007	.914	35	.010
E_Engagement_GW	.189	35	.003	.915	35	.010
E_Engagement_GW2	.243	35	.000	.892	35	.002
E_Engagement_SM	.245	35	.000	.899	35	.004
E_Engagement_SL	.185	35	.004	.907	35	.006
E_Engagement_SL2	.222	35	.000	.898	35	.004
S_Engagement_GP_Support	.320	35	.000	.794	35	.000
S_Engagement_GP_Support2	.239	35	.000	.897	35	.003
S_Engagement_GP_Support3	.197	35	.001	.909	35	.007
S_Engagement_GP_Message	.295	35	.000	.862	35	.000
S_Engagement_GP_Collaboration	.196	35	.002	.912	35	.008
S_Engagement_AP	.204	35	.001	.910	35	.007
S_Engagement_GW	.188	35	.003	.920	35	.014
S_Engagement_SM	.208	35	.001	.908	35	.007
S_Engagement_SL1	.210	35	.000	.899	35	.004
S_Engagement_SL2	.200	35	.001	.912	35	.009

a. Lilliefors Significance Correction

Appendix M: Exploratory experiment II - Non-Parametric Means test

Ranks

	Group	N	Mean Rank	Sum of Ranks
H_Education_GP_Support	Null	35	34.50	1207.50
	Participant	35	36.50	1277.50
	Total	70		
H_Education_GP_Message	Null	35	38.00	1330.00
	Participant	35	33.00	1155.00
	Total	70		
H_Education_GP_Collaboration	Null	35	33.00	1155.00
	Participant	35	38.00	1330.00
	Total	70		
H_Education_AP	Null	35	32.00	1120.00
	Participant	35	39.00	1365.00
	Total	70		
H_Education_GW	Null	35	25.00	875.00
	Participant	35	46.00	1610.00
	Total	70		
H_Education_GW2	Null	35	32.50	1137.50
	Participant	35	38.50	1347.50
	Total	70		
H_Education_SM	Null	35	40.00	1400.00
	Participant	35	31.00	1085.00
	Total	70		
H_Education_SM2	Null	35	39.00	1365.00
	Participant	35	32.00	1120.00
	Total	70		
H_Education_SL	Null	35	36.00	1260.00
	Participant	35	35.00	1225.00
	Total	70		
H_Education_SL2	Null	35	38.50	1347.50
	Participant	35	32.50	1137.50
	Total	70		
H_Social_GP_Support	Null	35	25.00	875.00
	Participant	35	46.00	1610.00
	Total	70		
H_Social_GP_Support2	Null	35	24.00	840.00
	Participant	35	47.00	1645.00
	Total	70		
H_Social_GP_Messgae	Null	35	40.50	1417.50
	Participant	35	30.50	1067.50
	Total	70		
H_Social_GP_Collaboration	Null	35	37.50	1312.50
	Participant	35	33.50	1172.50
	Total	70		
H_Social_AP	Null	35	33.00	1155.00
	Participant	35	38.00	1330.00
	Total	70		
H_Social_AP2	Null	35	37.50	1312.50
	Participant	35	33.50	1172.50
	Total	70		
H_Social_GW	Null	35	35.00	1225.00
	Participant	35	36.00	1260.00
	Total	70		
H_Social_SM	Null	35	44.00	1540.00
	Participant	35	27.00	945.00
	Total	70		
H_Social_SL	Null	35	31.50	1102.50
	Participant	35	39.50	1382.50
	Total	70		
H_Social_SL2	Null	35	30.00	1050.00
	Participant	35	41.00	1435.00
	Total	70		

H_Engagement_GP_Support	Null	35	39.00	1365.00
	Participant	35	32.00	1120.00
	Total	70		
H_Engagement_GP_Message	Null	35	42.50	1487.50
	Participant	35	28.50	997.50
	Total	70		
H_Engagement_GP_Collaboration	Null	35	42.00	1470.00
	Participant	35	29.00	1015.00
	Total	70		
H_Engagement_AP	Null	35	35.50	1242.50
	Participant	35	35.50	1242.50
	Total	70		
H_Engagement_AP2	Null	35	29.50	1032.50
	Participant	35	41.50	1452.50
	Total	70		
H_Engagement_GW	Null	35	26.00	910.00
	Participant	35	45.00	1575.00
	Total	70		
H_Engagement_SM	Null	35	39.50	1382.50
	Participant	35	31.50	1102.50
	Total	70		
H_Engagement_SL	Null	35	33.00	1155.00
	Participant	35	38.00	1330.00
	Total	70		
E_Social_GP_Support	Null	35	37.00	1295.00
	Participant	35	34.00	1190.00
	Total	70		
E_Social_GP_Messgae	Null	35	38.50	1347.50
	Participant	35	32.50	1137.50
	Total	70		
E_Social_GP_Collaboration	Null	35	36.50	1277.50
	Participant	35	34.50	1207.50
	Total	70		
E_Social_AP	Null	35	36.50	1277.50
	Participant	35	34.50	1207.50
	Total	70		
E_Social_AP2	Null	35	37.00	1295.00
	Participant	35	34.00	1190.00
	Total	70		
E_Social_GW	Null	35	25.00	875.00
	Participant	35	46.00	1610.00
	Total	70		
E_Social_GW2	Null	35	33.50	1172.50
	Participant	35	37.50	1312.50
	Total	70		
E_Social_SM	Null	35	42.00	1470.00
	Participant	35	29.00	1015.00
	Total	70		
E_Social_SM2	Null	35	40.50	1417.50
	Participant	35	30.50	1067.50
	Total	70		
E_Social_SL	Null	35	37.00	1295.00
	Participant	35	34.00	1190.00
	Total	70		
E_Engagement_GP_Support	Null	35	31.00	1085.00
	Participant	35	40.00	1400.00
	Total	70		
E_Engagement_GP_Messgae	Null	35	30.00	1050.00
	Participant	35	41.00	1435.00
	Total	70		
E_Engagement_GP_Collaboration	Null	35	40.50	1417.50
	Participant	35	30.50	1067.50
	Total	70		
E_Engagement_AP	Null	35	35.50	1242.50

	Participant	35	35.50	1242.50
	Total	70		
E_Engagement_GW	Null	35	33.50	1172.50
	Participant	35	37.50	1312.50
	Total	70		
E_Engagement_GW2	Null	35	28.50	997.50
	Participant	35	42.50	1487.50
	Total	70		
E_Engagement_SM	Null	35	37.50	1312.50
	Participant	35	33.50	1172.50
	Total	70		
E_Engagement_SL	Null	35	37.50	1312.50
	Participant	35	33.50	1172.50
	Total	70		
E_Engagement_SL2	Null	35	43.00	1505.00
	Participant	35	28.00	980.00
	Total	70		
S_Engagement_GP_Support	Null	35	29.00	1015.00
	Participant	35	42.00	1470.00
	Total	70		
S_Engagement_GP_Support2	Null	35	31.00	1085.00
	Participant	35	40.00	1400.00
	Total	70		
S_Engagement_GP_Support3	Null	35	33.50	1172.50
	Participant	35	37.50	1312.50
	Total	70		
S_Engagement_GP_Message	Null	35	29.50	1032.50
	Participant	35	41.50	1452.50
	Total	70		
S_Engagement_GP_Collaboration	Null	35	35.00	1225.00
	Participant	35	36.00	1260.00
	Total	70		
S_Engagement_AP	Null	35	40.50	1417.50
	Participant	35	30.50	1067.50
	Total	70		
S_Engagement_GW	Null	35	36.50	1277.50
	Participant	35	34.50	1207.50
	Total	70		
S_Engagement_SM	Null	35	39.50	1382.50
	Participant	35	31.50	1102.50
	Total	70		
S_Engagement_SL1	Null	35	33.50	1172.50
	Participant	35	37.50	1312.50
	Total	70		
S_Engagement_SL2	Null	35	32.50	1137.50
	Participant	35	38.50	1347.50
	Total	70		

Test Statistics

	H_Education_GP_Support	H_Education_GP_Message	H_Education_GP_Collaboration	H_Education_AP	H_Education_GW	H_Education_GW2
Mann-Whitney U	577.500	525.000	525.000	490.000	245.000	507.500
Wilcoxon W	1207.500	1155.000	1155.000	1120.000	875.000	1137.500
Z	-.488	-1.137	-1.235	-1.728	-4.991	-1.374
Asymp. Sig. (2-tailed)	.626	.255	.217	.084	.000	.169

	H_Education_SM	H_Education_SM2	H_Education_SL	H_Education_SL2	H_Social_GP_Support	H_Social_GP_Support2
Mann-Whitney U	455.000	490.000	595.000	507.500	245.000	210.000
Wilcoxon W	1085.000	1120.000	1225.000	1137.500	875.000	840.000
Z	-2.288	-1.647	-.241	-1.462	-4.902	-5.492
Asymp. Sig. (2-tailed)	.022	.099	.810	.144	.000	.000

	H_Social_GP_ Message	H_Social_GP_ Collaboration	H_Social_AP	H_Social_AP2	H_Social_GW	H_Social_SM
Mann-Whitney U	437.500	542.500	525.000	542.500	595.000	315.000
Wilcoxon W	1067.500	1172.500	1155.000	1172.500	1225.000	945.000
Z	-2.379	-.953	-1.206	-1.034	-.231	-3.933
Asymp. Sig. (2-tailed)	.017	.341	.228	.301	.817	.000

	H_Social_SL	H_Social_SL2	H_Engagement_ GP_Support	H_Engagement_ GP_Message	H_Engagement_ GP_ Collaboration	H_Engagement_ AP
Mann-Whitney U	472.500	420.000	490.000	367.500	385.000	612.500
Wilcoxon W	1102.500	1050.000	1120.000	997.500	1015.000	1242.500
Z	-1.951	-2.602	-1.649	-3.334	-3.011	.000
Asymp. Sig. (2-tailed)	.051	.009	.099	.001	.003	1.000

	H_Engagement_ AP2	H_Engagement_ GW	H_Engagement_ SM	H_Engagement_ SL	E_Social_GP_ Support	E_Social_GP_ Messgae
Mann-Whitney U	402.500	280.000	472.500	525.000	560.000	507.500
Wilcoxon W	1032.500	910.000	1102.500	1155.000	1190.000	1137.500
Z	-2.865	-4.426	-1.870	-1.157	-.707	-1.375
Asymp. Sig. (2-tailed)	.004	.000	.061	.247	.480	.169

	E_Social_GP_ Collaboration	E_Social_AP	E_Social_AP2	E_Social_GW	E_Social_GW2	E_Social_SM
Mann-Whitney U	577.500	577.500	560.000	245.000	542.500	385.000
Wilcoxon W	1207.500	1207.500	1190.000	875.000	1172.500	1015.000
Z	-.476	-.517	-.707	-4.982	-.975	-3.137
Asymp. Sig. (2-tailed)	.634	.605	.480	.000	.330	.002

	E_Social_SM2	E_Social_SL	E_Engagement_ GP_Support	E_Engagement_ GP_Messgae	E_Engagement_ GP_ Collaboration	E_Engagement_ AP
Mann-Whitney U	437.500	560.000	455.000	420.000	437.500	612.500
Wilcoxon W	1067.500	1190.000	1085.000	1050.000	1067.500	1242.500
Z	-2.379	-.706	-2.129	-2.658	-2.338	.000
Asymp. Sig. (2-tailed)	.017	.480	.033	.008	.019	1.000

	E_Engagement_ GW	E_Engagement_ GW2	E_Engagement_ SM	E_Engagement_ SL	E_Engagement_ SL2	S_Engagement_ GP_Support
Mann-Whitney U	542.500	367.500	542.500	542.500	350.000	385.000
Wilcoxon W	1172.500	997.500	1172.500	1172.500	980.000	1015.000
Z	-.975	-3.339	-1.033	-.974	-3.617	-3.090
Asymp. Sig. (2-tailed)	.330	.001	.302	.330	.000	.002

	S_Engagement_ GP_Support2	S_Engagement_ GP_Support3	S_Engagement_ GP_Message	S_Engagement_ GP_ Collaboration	S_Engagement_ AP	S_Engagement _GW
Mann-Whitney U	455.000	542.500	402.500	595.000	437.500	577.500
Wilcoxon W	1085.000	1172.500	1032.500	1225.000	1067.500	1207.500
Z	-2.172	-1.002	-2.813	-.247	-2.439	-.500
Asymp. Sig. (2-tailed)	.030	.316	.005	.805	.015	.617

	S_Engagement_ SM	S_Engagement_ SL1	S_Engagement_ SL2
Mann-Whitney U	472.500	542.500	507.500
Wilcoxon W	1102.500	1172.500	1137.500
Z	-2.003	-.952	-1.502
Asymp. Sig. (2-tailed)	.045	.341	.133

a. Grouping Variable: Group

Appendix N: Output of the Normality tests

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
H_Education_GP_Support	.318	20	.000	.833	20	.003
H_Education_GP_Message	.252	20	.002	.858	20	.007
H_Education_GP_Collaboration	.225	20	.009	.887	20	.023
H_Education_AP	.275	20	.000	.767	20	.000
H_Education_GW	.247	20	.002	.869	20	.011
H_Education_GW2	.266	20	.001	.832	20	.003
H_Education_SM	.375	20	.000	.720	20	.000
H_Education_SM2	.323	20	.000	.823	20	.002
H_Education_SL	.375	20	.000	.775	20	.000
H_Education_SL2	.255	20	.001	.881	20	.018
H_Social_GP_Support	.318	20	.000	.833	20	.003
H_Social_GP_Support2	.263	20	.001	.800	20	.001
H_Social_GP_Messgae	.294	20	.000	.829	20	.002
H_Social_GP_Collaboration	.279	20	.000	.807	20	.001
H_Social_AP	.238	20	.004	.868	20	.011
H_Social_AP2	.336	20	.000	.821	20	.002
H_Social_GW	.303	20	.000	.850	20	.005
H_Social_SM	.286	20	.000	.867	20	.010
H_Social_SL	.300	20	.000	.832	20	.003
H_Social_SL2	.268	20	.001	.858	20	.007
H_Engagement_GP_Support	.308	20	.000	.765	20	.000
H_Engagement_GP_Message	.413	20	.000	.608	20	.000
H_Engagement_GP_Collaboration	.252	20	.002	.858	20	.007
H_Engagement_AP	.287	20	.000	.863	20	.009
H_Engagement_AP2	.268	20	.001	.858	20	.007
H_Engagement_GW	.302	20	.000	.780	20	.000
H_Engagement_SM	.336	20	.000	.821	20	.002
H_Engagement_SL	.263	20	.001	.800	20	.001
E_Social_GP_Support	.266	20	.001	.855	20	.006
E_Social_GP_Messgae	.227	20	.008	.898	20	.038
E_Social_GP_Collaboration	.424	20	.000	.632	20	.000
E_Social_AP	.376	20	.000	.767	20	.000
E_Social_AP2	.339	20	.000	.739	20	.000
E_Social_GW	.350	20	.000	.775	20	.000
E_Social_GW2	.252	20	.002	.795	20	.001
E_Social_SM	.303	20	.000	.850	20	.005
E_Social_SM2	.271	20	.000	.853	20	.006
E_Social_SL	.284	20	.000	.773	20	.000
E_Engagement_GP_Support	.336	20	.000	.821	20	.002
E_Engagement_GP_Messgae	.300	20	.000	.793	20	.001
E_Engagement_GP_Collaboration	.233	20	.006	.887	20	.024
E_Engagement_AP	.252	20	.002	.795	20	.001
E_Engagement_GW	.275	20	.000	.864	20	.009
E_Engagement_GW2	.351	20	.000	.754	20	.000
E_Engagement_SM	.346	20	.000	.814	20	.001
E_Engagement_SL	.255	20	.001	.812	20	.001
E_Engagement_SL2	.309	20	.000	.842	20	.004
S_Engagement_GP_Support	.288	20	.000	.798	20	.001
S_Engagement_GP_Support2	.312	20	.000	.788	20	.001
S_Engagement_GP_Support3	.246	20	.003	.870	20	.012
S_Engagement_GP_Message	.333	20	.000	.768	20	.000
S_Engagement_GP_Collaboration	.297	20	.000	.841	20	.004
S_Engagement_AP	.499	20	.000	.447	20	.000
S_Engagement_GW	.317	20	.000	.843	20	.004
S_Engagement_SM	.363	20	.000	.790	20	.001
S_Engagement_SL1	.312	20	.000	.788	20	.001
S_Engagement_SL2	.230	20	.007	.809	20	.001

Appendix O: Independent-Samples T-test

Group Statistics

	Group	N	Mean	Std. Deviation	Std. Error Mean
H_Education_GP_Support	Null	20	3.0000	.00000	.00000
	Participant	20	3.8500	.87509	.19568
H_Education_GP_Message	Null	20	3.0000	.00000	.00000
	Participant	20	3.4000	.75394	.16859
H_Education_GP_Collaboration	Null	20	3.0000	.00000	.00000
	Participant	20	3.6000	.88258	.19735
H_Education_AP	Null	20	3.0000	.00000	.00000
	Participant	20	3.2500	.78640	.17584
H_Education_GW	Null	20	3.0000	.00000	.00000
	Participant	20	3.9000	.85224	.19057
H_Education_GW2	Null	20	3.0000	.00000	.00000
	Participant	20	3.5000	.68825	.15390
H_Education_SM	Null	20	3.0000	.00000	.00000
	Participant	20	2.7500	.55012	.12301
H_Education_SM2	Null	20	3.0000	.00000	.00000
	Participant	20	3.4500	.75915	.16975
H_Education_SL	Null	20	3.0000	.00000	.00000
	Participant	20	3.7500	.78640	.17584
H_Education_SL2	Null	20	3.0000	.00000	.00000
	Participant	20	3.3500	.87509	.19568
H_Social_GP_Support	Null	20	3.0000	.00000	.00000
	Participant	20	3.8500	.87509	.19568
H_Social_GP_Support2	Null	20	3.0000	.00000	.00000
	Participant	20	3.8000	.69585	.15560
H_Social_GP_Messgae	Null	20	3.0000	.00000	.00000
	Participant	20	3.4500	.68633	.15347
H_Social_GP_Collaboration	Null	20	3.0000	.00000	.00000
	Participant	20	3.0500	.68633	.15347
H_Social_AP	Null	20	3.0000	.00000	.00000
	Participant	20	3.6500	.81273	.18173
H_Social_AP2	Null	20	3.0000	.00000	.00000
	Participant	20	3.2500	.71635	.16018
H_Social_GW	Null	20	3.0000	.00000	.00000
	Participant	20	3.8000	.76777	.17168
H_Social_SM	Null	20	3.0000	.00000	.00000
	Participant	20	3.3000	.86450	.19331
H_Social_SL	Null	20	3.0000	.00000	.00000
	Participant	20	4.0000	.79472	.17770
H_Social_SL2	Null	20	3.0000	.00000	.00000
	Participant	20	3.6000	.82078	.18353
H_Engagement_GP_Support	Null	20	3.0000	.00000	.00000
	Participant	20	3.6500	.74516	.16662
H_Engagement_GP_Message	Null	20	3.0000	.00000	.00000
	Participant	20	3.3500	.48936	.10942
H_Engagement_GP_Collaboration	Null	20	3.0000	.00000	.00000
	Participant	20	3.4000	.75394	.16859
H_Engagement_AP	Null	20	3.0000	.00000	.00000
	Participant	20	3.4000	.82078	.18353
H_Engagement_AP2	Null	20	3.0000	.00000	.00000
	Participant	20	3.6000	.82078	.18353
H_Engagement_GW	Null	20	3.0000	.00000	.00000
	Participant	20	3.7500	.63867	.14281
H_Engagement_SM	Null	20	3.0000	.00000	.00000
	Participant	20	3.2500	.71635	.16018
H_Engagement_SL	Null	20	3.0000	.00000	.00000
	Participant	20	3.8000	.69585	.15560
E_Social_GP_Support	Null	20	3.0000	.00000	.00000
	Participant	20	3.5500	.75915	.16975

E_Social_GP_Messgae	Null	20	3.0000	.00000	.00000
	Participant	20	3.4000	.99472	.22243
E_Social_GP_Collaboration	Null	20	3.0000	.00000	.00000
	Participant	20	3.3500	.58714	.13129
E_Social_AP	Null	20	3.0000	.00000	.00000
	Participant	20	3.3000	.65695	.14690
E_Social_AP2	Null	20	3.0000	.00000	.00000
	Participant	20	3.5500	.68633	.15347
E_Social_GW	Null	20	3.0000	.00000	.00000
	Participant	20	4.0000	.72548	.16222
E_Social_GW2	Null	20	3.0000	.00000	.00000
	Participant	20	3.7500	.71635	.16018
E_Social_SM	Null	20	3.0000	.00000	.00000
	Participant	20	2.9000	.85224	.19057
E_Social_SM2	Null	20	3.0000	.00000	.00000
	Participant	20	3.6500	.87509	.19568
E_Social_SL	Null	20	3.0000	.00000	.00000
	Participant	20	3.6500	.67082	.15000
E_Engagement_GP_Support	Null	20	3.0000	.00000	.00000
	Participant	20	3.7500	.71635	.16018
E_Engagement_GP_Messgae	Null	20	3.0000	.00000	.00000
	Participant	20	4.0000	.64889	.14510
E_Engagement_GP_Collaboration	Null	20	3.0000	.00000	.00000
	Participant	20	3.4500	.94451	.21120
E_Engagement_AP	Null	20	3.0000	.00000	.00000
	Participant	20	3.7500	.71635	.16018
E_Engagement_GW	Null	20	3.0000	.00000	.00000
	Participant	20	3.7500	.78640	.17584
E_Engagement_GW2	Null	20	3.0000	.00000	.00000
	Participant	20	3.8500	.58714	.13129
E_Engagement_SM	Null	20	3.0000	.00000	.00000
	Participant	20	3.3000	.80131	.17918
E_Engagement_SL	Null	20	3.0000	.00000	.00000
	Participant	20	3.9000	.71818	.16059
E_Engagement_SL2	Null	20	3.0000	.00000	.00000
	Participant	20	3.3000	.73270	.16384
S_Engagement_GP_Support	Null	20	3.0000	.00000	.00000
	Participant	20	4.1500	.67082	.15000
S_Engagement_GP_Support2	Null	20	3.0000	.00000	.00000
	Participant	20	4.1000	.64072	.14327
S_Engagement_GP_Support3	Null	20	3.0000	.00000	.00000
	Participant	20	3.7000	.80131	.17918
S_Engagement_GP_Message	Null	20	3.0000	.00000	.00000
	Participant	20	3.9500	.60481	.13524
S_Engagement_GP_Collaboration	Null	20	3.0000	.00000	.00000
	Participant	20	3.5500	.82558	.18460
S_Engagement_AP	Null	20	3.0000	.00000	.00000
	Participant	20	3.2000	.52315	.11698
S_Engagement_GW	Null	20	3.0000	.00000	.00000
	Participant	20	3.3500	.81273	.18173
S_Engagement_SM	Null	20	3.0000	.00000	.00000
	Participant	20	3.2000	.69585	.15560
S_Engagement_SL1	Null	20	3.0000	.00000	.00000
	Participant	20	4.1000	.64072	.14327
S_Engagement_SL2	Null	20	3.0000	.00000	.00000
	Participant	20	3.8500	.74516	.16662

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of Difference	
									Lower	Upper
H_Education_GP_Support	Equal variances assumed	22.032	.000	-4.344	38	.000	-.85000	.19568	-1.24613	-.45387
	Equal variances not assumed			-4.344	19.000	.000	-.85000	.19568	-1.25956	-.44044
H_Education_GP_Message	Equal variances assumed	59.681	.000	-2.373	38	.023	-.40000	.16859	-.74128	-.05872
	Equal variances not assumed			-2.373	19.000	.028	-.40000	.16859	-.75285	-.04715
H_Education_GP_Collaboration	Equal variances assumed	54.077	.000	-3.040	38	.004	-.60000	.19735	-.99952	-.20048
	Equal variances not assumed			-3.040	19.000	.007	-.60000	.19735	-1.01306	-.18694
H_Education_AP	Equal variances assumed	30.066	.000	-1.422	38	.163	-.25000	.17584	-.60598	.10598
	Equal variances not assumed			-1.422	19.000	.171	-.25000	.17584	-.61805	.11805
H_Education_GW	Equal variances assumed	27.755	.000	-4.723	38	.000	-.90000	.19057	-1.28578	-.51422
	Equal variances not assumed			-4.723	19.000	.000	-.90000	.19057	-1.29886	-.50114
H_Education_GW2	Equal variances assumed	76.000	.000	-3.249	38	.002	-.50000	.15390	-.81155	-.18845
	Equal variances not assumed			-3.249	19.000	.004	-.50000	.15390	-.82211	-.17789
H_Education_SM	Equal variances assumed	45.265	.000	2.032	38	.049	.25000	.12301	.00098	.49902
	Equal variances not assumed			2.032	19.000	.056	.25000	.12301	-.00746	.50746
H_Education_SM2	Equal variances assumed	56.435	.000	-2.651	38	.012	-.45000	.16975	-.79365	-.10635
	Equal variances not assumed			-2.651	19.000	.016	-.45000	.16975	-.80530	-.09470
H_Education_SL	Equal variances assumed	24.455	.000	-4.265	38	.000	-.75000	.17584	-1.10598	-.39402
	Equal variances not assumed			-4.265	19.000	.000	-.75000	.17584	-1.11805	-.38195
H_Education_SL2	Equal variances assumed	47.105	.000	-1.789	38	.082	-.35000	.19568	-.74613	.04613
	Equal variances not assumed			-1.789	19.000	.090	-.35000	.19568	-.75956	.05956

H_Social_GP_ Support	Equal variances assumed	22.032	.000	-4.344	38	.000	-.85000	.19568	-1.24613	-.45387
	Equal variances not assumed			-4.344	19.000	.000	-.85000	.19568	-1.25956	-.44044
H_Social_GP_ Support2	Equal variances assumed	40.699	.000	-5.141	38	.000	-.80000	.15560	-1.11499	-.48501
	Equal variances not assumed			-5.141	19.000	.000	-.80000	.15560	-1.12567	-.47433
H_Social_GP_ Messgae	Equal variances assumed	71.960	.000	-2.932	38	.006	-.45000	.15347	-.76068	-.13932
	Equal variances not assumed			-2.932	19.000	.009	-.45000	.15347	-.77121	-.12879
H_Social_GP_ Collaboration	Equal variances assumed	19.321	.000	-.326	38	.746	-.05000	.15347	-.36068	.26068
	Equal variances not assumed			-.326	19.000	.748	-.05000	.15347	-.37121	.27121
H_Social_AP	Equal variances assumed	56.328	.000	-3.577	38	.001	-.65000	.18173	-1.01790	-.28210
	Equal variances not assumed			-3.577	19.000	.002	-.65000	.18173	-1.03037	-.26963
H_Social_AP2	Equal variances assumed	31.068	.000	-1.561	38	.127	-.25000	.16018	-.57427	.07427
	Equal variances not assumed			-1.561	19.000	.135	-.25000	.16018	-.58526	.08526
H_Social_GW	Equal variances assumed	28.585	.000	-4.660	38	.000	-.80000	.17168	-1.14755	-.45245
	Equal variances not assumed			-4.660	19.000	.000	-.80000	.17168	-1.15933	-.44067
H_Social_SM	Equal variances assumed	38.674	.000	-1.552	38	.129	-.30000	.19331	-.69133	.09133
	Equal variances not assumed			-1.552	19.000	.137	-.30000	.19331	-.70460	.10460
H_Social_SL	Equal variances assumed	13.571	.001	-5.627	38	.000	-1.00000	.17770	-1.35974	-.64026
	Equal variances not assumed			-5.627	19.000	.000	-1.00000	.17770	-1.37194	-.62806
H_Social_SL2	Equal variances assumed	62.067	.000	-3.269	38	.002	-.60000	.18353	-.97154	-.22846
	Equal variances not assumed			-3.269	19.000	.004	-.60000	.18353	-.98414	-.21586
H_Engagement _GP_Support	Equal variances assumed	76.452	.000	-3.901	38	.000	-.65000	.16662	-.98731	-.31269
	Equal variances not assumed			-3.901	19.000	.001	-.65000	.16662	-.99875	-.30125
H_Engagement _GP_Message	Equal variances assumed	192.111	.000	-3.199	38	.003	-.35000	.10942	-.57152	-.12848

	Equal variances not assumed			-3.199	19.000	.005	-.35000	.10942	-.57903	-.12097
H_Engagement_GP_Collaboration	Equal variances assumed	59.681	.000	-2.373	38	.023	-.40000	.16859	-.74128	-.05872
	Equal variances not assumed			-2.373	19.000	.028	-.40000	.16859	-.75285	-.04715
H_Engagement_AP	Equal variances assumed	49.468	.000	-2.179	38	.036	-.40000	.18353	-.77154	-.02846
	Equal variances not assumed			-2.179	19.000	.042	-.40000	.18353	-.78414	-.01586
H_Engagement_AP2	Equal variances assumed	62.067	.000	-3.269	38	.002	-.60000	.18353	-.97154	-.22846
	Equal variances not assumed			-3.269	19.000	.004	-.60000	.18353	-.98414	-.21586
H_Engagement_GW	Equal variances assumed	46.810	.000	-5.252	38	.000	-.75000	.14281	-1.03910	-.46090
	Equal variances not assumed			-5.252	19.000	.000	-.75000	.14281	-1.04891	-.45109
H_Engagement_SM	Equal variances assumed	31.068	.000	-1.561	38	.127	-.25000	.16018	-.57427	.07427
	Equal variances not assumed			-1.561	19.000	.135	-.25000	.16018	-.58526	.08526
H_Engagement_SL	Equal variances assumed	40.699	.000	-5.141	38	.000	-.80000	.15560	-1.11499	-.48501
	Equal variances not assumed			-5.141	19.000	.000	-.80000	.15560	-1.12567	-.47433
E_Social_GP_Support	Equal variances assumed	64.220	.000	-3.240	38	.002	-.55000	.16975	-.89365	-.20635
	Equal variances not assumed			-3.240	19.000	.004	-.55000	.16975	-.90530	-.19470
E_Social_GP_Messgae	Equal variances assumed	40.533	.000	-1.798	38	.080	-.40000	.22243	-.85028	.05028
	Equal variances not assumed			-1.798	19.000	.088	-.40000	.22243	-.86554	.06554
E_Social_GP_Collaboration	Equal variances assumed	52.196	.000	-2.666	38	.011	-.35000	.13129	-.61578	-.08422
	Equal variances not assumed			-2.666	19.000	.015	-.35000	.13129	-.62479	-.07521
E_Social_AP	Equal variances assumed	36.802	.000	-2.042	38	.048	-.30000	.14690	-.59738	-.00262
	Equal variances not assumed			-2.042	19.000	.055	-.30000	.14690	-.60746	.00746
E_Social_AP2	Equal variances assumed	85.357	.000	-3.584	38	.001	-.55000	.15347	-.86068	-.23932
	Equal variances not assumed			-3.584	19.000	.002	-.55000	.15347	-.87121	-.22879

E_Social_GW	Equal variances assumed	8.941	.005	-6.164	38	.000	-1.00000	.16222	-1.32840	-.67160
	Equal variances not assumed			-6.164	19.000	.000	-1.00000	.16222	-1.33953	-.66047
E_Social_GW2	Equal variances assumed	53.647	.000	-4.682	38	.000	-.75000	.16018	-1.07427	-.42573
	Equal variances not assumed			-4.682	19.000	.000	-.75000	.16018	-1.08526	-.41474
E_Social_SM	Equal variances assumed	14.832	.000	.525	38	.603	.10000	.19057	-.28578	.48578
	Equal variances not assumed			.525	19.000	.606	.10000	.19057	-.29886	.49886
E_Social_SM2	Equal variances assumed	64.773	.000	-3.322	38	.002	-.65000	.19568	-1.04613	-.25387
	Equal variances not assumed			-3.322	19.000	.004	-.65000	.19568	-1.05956	-.24044
E_Social_SL	Equal variances assumed	76.251	.000	-4.333	38	.000	-.65000	.15000	-.95366	-.34634
	Equal variances not assumed			-4.333	19.000	.000	-.65000	.15000	-.96395	-.33605
E_Engagement_GP_Support	Equal variances assumed	31.068	.000	-4.682	38	.000	-.75000	.16018	-1.07427	-.42573
	Equal variances not assumed			-4.682	19.000	.000	-.75000	.16018	-1.08526	-.41474
E_Engagement_GP_Messgae	Equal variances assumed	12.667	.001	-6.892	38	.000	-1.00000	.14510	-1.29373	-.70627
	Equal variances not assumed			-6.892	19.000	.000	-1.00000	.14510	-1.30369	-.69631
E_Engagement_GP_Collaboration	Equal variances assumed	55.730	.000	-2.131	38	.040	-.45000	.21120	-.87755	-.02245
	Equal variances not assumed			-2.131	19.000	.046	-.45000	.21120	-.89205	-.00795
E_Engagement_AP	Equal variances assumed	53.647	.000	-4.682	38	.000	-.75000	.16018	-1.07427	-.42573
	Equal variances not assumed			-4.682	19.000	.000	-.75000	.16018	-1.08526	-.41474
E_Engagement_GW	Equal variances assumed	37.698	.000	-4.265	38	.000	-.75000	.17584	-1.10598	-.39402
	Equal variances not assumed			-4.265	19.000	.000	-.75000	.17584	-1.11805	-.38195
E_Engagement_GW2	Equal variances assumed	23.366	.000	-6.474	38	.000	-.85000	.13129	-1.11578	-.58422
	Equal variances not assumed			-6.474	19.000	.000	-.85000	.13129	-1.12479	-.57521
E_Engagement_SM	Equal variances assumed	32.374	.000	-1.674	38	.102	-.30000	.17918	-.66273	.06273

	Equal variances not assumed			-1.674	19.000	.110	-.30000	.17918	-.67503	.07503
E_Engagement_SL	Equal variances assumed	27.925	.000	-5.604	38	.000	-.90000	.16059	-1.22510	-.57490
	Equal variances not assumed			-5.604	19.000	.000	-.90000	.16059	-1.23612	-.56388
E_Engagement_SL2	Equal variances assumed	40.852	.000	-1.831	38	.075	-.30000	.16384	-.63167	.03167
	Equal variances not assumed			-1.831	19.000	.083	-.30000	.16384	-.64291	.04291
S_Engagement_GP_Support	Equal variances assumed	29.522	.000	-7.667	38	.000	-1.15000	.15000	-1.45366	-.84634
	Equal variances not assumed			-7.667	19.000	.000	-1.15000	.15000	-1.46395	-.83605
S_Engagement_GP_Support2	Equal variances assumed	20.520	.000	-7.678	38	.000	-1.10000	.14327	-1.39004	-.80996
	Equal variances not assumed			-7.678	19.000	.000	-1.10000	.14327	-1.39987	-.80013
S_Engagement_GP_Support3	Equal variances assumed	47.456	.000	-3.907	38	.000	-.70000	.17918	-1.06273	-.33727
	Equal variances not assumed			-3.907	19.000	.001	-.70000	.17918	-1.07503	-.32497
S_Engagement_GP_Message	Equal variances assumed	13.509	.001	-7.025	38	.000	-.95000	.13524	-1.22378	-.67622
	Equal variances not assumed			-7.025	19.000	.000	-.95000	.13524	-1.23306	-.66694
S_Engagement_GP_Collaboration	Equal variances assumed	62.758	.000	-2.979	38	.005	-.55000	.18460	-.92371	-.17629
	Equal variances not assumed			-2.979	19.000	.008	-.55000	.18460	-.93638	-.16362
S_Engagement_AP	Equal variances assumed	15.211	.000	-1.710	38	.095	-.20000	.11698	-.43681	.03681
	Equal variances not assumed			-1.710	19.000	.104	-.20000	.11698	-.44484	.04484
S_Engagement_GW	Equal variances assumed	41.071	.000	-1.926	38	.062	-.35000	.18173	-.71790	.01790
	Equal variances not assumed			-1.926	19.000	.069	-.35000	.18173	-.73037	.03037
S_Engagement_SM	Equal variances assumed	22.619	.000	-1.285	38	.206	-.20000	.15560	-.51499	.11499
	Equal variances not assumed			-1.285	19.000	.214	-.20000	.15560	-.52567	.12567
S_Engagement_SL1	Equal variances assumed	20.520	.000	-7.678	38	.000	-1.10000	.14327	-1.39004	-.80996
	Equal variances not assumed			-7.678	19.000	.000	-1.10000	.14327	-1.39987	-.80013

S_Engagement_SL2	Equal variances assumed	38.775	.000	-5.101	38	.000	-.85000	.16662	-1.18731	-.51269
	Equal variances not assumed			-5.101	19.000	.000	-.85000	.16662	-1.19875	-.50125