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Centre for Creativity in Professional Practice
School of Mathematics, Computer Science and Engineering
City University London

A Thesis presented for the degree of Doctor of Philosophy

Creativity support in games for motivated learning

by Anja Sisarica

Supervised by Prof Neil Maiden & Prof Julianne Meyer
September, 2015



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For Zdravko & Dragana

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Declaration

The work in this thesis is based on research carried out at the Centre for Human-Computer Interaction Design and Centre for Creativity in Professional Practice at City University, London, England. No part of this thesis has been submitted elsewhere for any other degree or qualification. All work is my own unless otherwise stated.

Signed: (Anja Sisarica)

Date:

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Abstract

A natural extension of play for creative thinking can innovatively drive technology-led changes to the facilitation of creative problem solving, and generate a new genre in serious gaming. Whilst the use of serious games has grown considerably in recent years, support for players to think creatively is often implicit in the game, and does not exploit the wide range of creativity techniques and software tools available. The work reported in this thesis is the first to explicitly integrate creativity support into serious games. The results show that creative serious games can systematically support acquisition of creativity skills, generation of creative learning outcomes, and induction of motivational and learning benefits amongst the players.

Therefore, this thesis introduces the concept of explicit creativity support in serious games, with a focus on games for motivated learning in adult professional setting, and reports formative and summative evaluations of new prototype games for this setting, in order to instantiate, refine and validate the concept. The creative learning objective of the prototype games was to train carers in creativity techniques to deliver more person-centred care to people with dementia.

The findings are delivered in the form of a new framework, which proposes recommendations for the design and understanding of creative serious games. Four formative evaluations of three prototypes of creative serious games with carers provided results that led to refinements of the framework and the design of more usable and effective games. A subsequent summative evaluation partially validated the framework, delivering both a framework and prototype creative serious game that demonstrated the potential to improve person-centred dementia care training. The thesis provides a proof-of-concept of the value of creative serious games, and shows the potential for the framework to be applied and have impact on other application domains.

Keywords: *creativity; creative problem solving; creative learning; serious games; games technologies; person-centred care; dementia; training; engagement; design; prototyping; reflection.*

Chapter 1 – Problem Statement

"Let my playing be my learning, and my learning be my playing"

- Johan Huizinga, *Homo Ludens*, 1938

1.1 Introduction

Motivated learning is a term that represents the reciprocal nature of the relation between motivation and learning: motivation influences learning and performance, and what one does and learns in the process of learning influences one's motivation levels [48, 200]. A motivated learner has a willingness to engage in a learning task, and an intrinsic motivation to continue learning. This recursive process can be embedded in games [142], and computer-based serious games employ game mechanics to deliver social change and motivated learning rather than entertainment [111]. Interest in such game forms has increased significantly over the last five years. For example, Gartner [67] predicts that by 2015, more than 50% of organisations that manage innovation processes will have gamified those processes. Examples of domains for which serious games have been effectively delivered include defense, education, science, health care, city planning, engineering, religion, and politics [153].

Jane McGonigal was one of the first researchers to explore the question of how games could change the way we think and act in everyday life, pioneering the field in 2008 with an argument that “reality is broken, and we need to start making games to fix it” [123, p.9]. The outcome that she argued in her work is that we should not aim at making games that are better and more immersive alternatives to reality – but rather at making the world become a better and more immersive reality. Since then, numerous studies have revealed the positive effects of explicitly designing games to improve the quality of life by providing opportunities to solve problems and intervene in social situations (e.g. moderating the acquisition of skillsets among diverse user groups [153, 160]).

But what would happen if, instead of imposing solutions, we let the players create a “reality fix” of their own? There has been little research that sought to introduce techniques to encourage creative thinking explicitly to support such problem solving and technology-enhanced social interventions in game-based learning. Indeed, although there are serious games that appear to have been designed to support creative exploration by users [74], most do not explicitly support creative problem solving using established creativity techniques [129] and software tools [168]. If creativity can be incorporated into serious games, then it can potentially allow players not only to immerse themselves in stories that make things meaningful [104] within game environments, but also to create their own stories, ideas and reflection spaces [24] beyond a game simulation. Creativity within games can also mean allowing the players in the game space to generate new rules that the designer had not considered (e.g. as in the *Nomic* game [203]). My doctoral project addresses this knowledge gap by contributing and exploring one new connection between the fields of creative problem solving and serious games.

1.2 Context and motivation

My motivation is to envision a new form of domain-independent and playful training support that utilises game mechanics to engage in reflective conversation and creative thinking. This approach has the potential to be applied particularly in application domains that often require human creative problem solving and customisation (e.g. education, health, design,

management, consulting, arts). Proposing a theoretical framework that is domain-independent, therefore, has numerous benefits in terms of exploitation. However, its recommendations have to be taken with caution, as an in-depth evaluation requires more case studies in different domains. Investigating the generalisation of this hypothesis and the domain-independent nature of my theoretical recommendations would indeed be too big of a task for a single doctoral project. Therefore, I focused my research on the challenges posed by only one domain: personalized dementia care.

Dementia is a condition related to ageing, with major consequences for health and social care provision. For example, there are currently 750,000 people with dementia in the UK alone, a figure expected to double by 2050 [196]. Dementia care is often delivered in residential homes, and in the UK, two-thirds of all home residents have some form of dementia [196]. Serious games are already emerging as an important means of training care staff in residential homes, for example as an immersive virtual care home in which trainee carers can experience, resolve and reflect on challenging situations in a virtual, and hence safe environment [142]. However, an emerging need for creative thinking in dementia care has arisen from the shift towards person-centred care [26] that recognizes the uniqueness of each resident and/or carer, and some related work [114] supports this new model of the delivery of care to older people with dementia.

A person-centred approach is central to good practice in dementia care, and is as important for people who receive services as it is to staff [61]. To successfully provide it, one needs to have an open

mind and a measure of creativity when faced with challenges [114]. Care needs to be adapted to the individual resident [26, 133], a form of activity that requires occasional creative problem solving to produce novel and useful care [177] unique to the resident.

People with dementia in economies where attaining great age has become the norm are increasingly cared for in residential homes by carers – typically busy women, often mothers and housewives who are not highly paid [133]. Training these carers in person-centered care practices and techniques to deliver care that is often adapted to each individual, and hence new to carers, has become a major challenge for care sectors in these economies [1, 26, 33, 47, 85, 128].

The FP7 Integrated Project MIRROR (2010-2014) has already demonstrated some benefits of technology support in dementia care. The project contributed a simulation environment for motivated training of dementia care staff, as a PC serious game in 3D single-player format with a virtual tutor, called Virtual Care Home [143]. This environment supported reflection about typical forms of challenging behaviour exhibited by residents. A trainee carer could experience, resolve and reflect on different challenging situations in a virtual and hence safe environment. Trainee carers received tutorial guidance from a virtual learning companion [143]. However, this Virtual Care Home environment provided no explicit support for creative thinking in order to generate novel plans to manage challenging behaviour and, at best, limited support for implicit creative problem solving in the form of game simulations that carers can run (e.g. game characters posing

questions to create dilemmas for the players, but without supporting the players with techniques to address these dilemmas creatively or provide creative input to the game), which were platform-dependent and provided with limited instructional content. In contrast, other research undertaken in the scope of the Mirror project has revealed the potential for creative thinking by carers to enhance person-centered care, for example using a mobile app to support different forms of the *other worlds* creativity technique in response to encountered challenging behaviors [114, 199]. This technique encourages carers to address the chosen problem in a domain analogical to the problem domain, and then transfer the gained insight [129]. During evaluations of the app use in residential homes, carers were both receptive to face-to-face training in creativity techniques and able to use the creativity support app to change resident care [114].

In order to bridge these existing research efforts, my doctoral research explores the emerging possibilities of incorporating creativity and games technology in the application domain of person-centred dementia care (Figure 1-1). In particular, I focused on serious game design that supports immediate creative problem solving and the acquisition of creative thinking skills, exemplified in the context of care staff training. This was my original contribution to the body of knowledge and role within the MIRROR project.

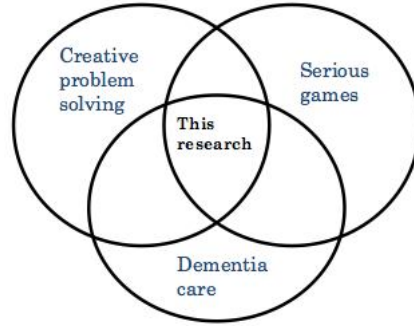


Figure 1-1: Doctoral research interdisciplinary context, bridging the gap between creativity techniques, serious games and dementia care.

Existing theories of Creative Problem Solving (CPS) and games for social change and motivated learning are open to extension to support the creative learning process and enhance user experience in terms of innovation [180], flow [32], self-organization [152] and fun [104]. In the next two sections, let us consider the bilateral opportunities for integrating creativity support into serious games: how to play more creatively (Section 1.2.1) and how to create more playfully (Section 1.2.2).

1.2.1 Playing creatively

Play is defined as an activity that is “intrinsically motivated, self-directed; free from externally imposed rules; and it involves positive effects such as pleasure, joy, excitement and fun” [162, p.71]. Playful interventions are activities that are aimed to teach one “how to play in a developmentally more advantageous way” [162, p.72]. My assumption is that SGs could be a form of playful interventions that foster CPS and motivated learning.

There is increasing evidence that utilizing games to train and educate is effective [3, 98, 145]. One consequence has been widespread gamification that has resulted in many different types of serious games [180], for example to train marine staff [14], treat cockroach phobia [23], overcome negative emotions [181], manage large-scale investment resources [87] and rediscover cultural heritage [70]. My assumption is that the trend of growth has the potential to be enhanced, and in return induce significant impact on various communities, if the game-based learning experience is empowered by integrating a creative approach to problem solving into games' properties.

Creativity is defined as “the ability to produce work that is both novel (i.e. original, unexpected) and appropriate (i.e. useful, adaptive to task constraints)” [89, p.5]. There are many problems in the world that could be effectively addressed non-creatively, by using existing or previous solutions, delegating or consulting. However, there are also some vital tasks in professional environments that require outcomes that are new, unstructured and open-ended because no ready-made answers exist. Both working and gaming often include the following 2 processes that ask for such creative approach in problem solving [152].

- 1) *Making decisions.* In contrast to non-creative decision-making that is often highly constrained, procedural and passive, creative decision-making is more flexible, adaptive and active. Harteveld's [80] design philosophy treats a serious game as a multi-objective problem, in which trade-offs need to be made in a space defined by play, meaning and reality. Players must trade-off during a game (i.e. choose or balance between the conflicting

factors). I assume that encouraging players to rethink these trade-offs in engaging, non-repeatable and self-regenerating ways could encourage collaborative creative problem solving in game play. Indeed, the complex strategies and behaviours that a player can demonstrate from a simple set of rules can enable effective learning, in contrast to games in which users simply play digitized versions of quizzes that do not lead to knowledge retention [105].

2) *Developing and designing new applications, ideas, relationships, systems, or products* [152]. The rule sets and resources that each game provides can still constrain creative thinking – perhaps the player generates a new idea or seeks to undertake a new behavior that the game’s developer did not consider [74], and therefore cannot use or do. New rule and resource generation appears to be an important characteristic of creative serious games (see Sections 2.1.2.1 and 2.1.2.2) – one that is shifting games from simulation to interaction in order to create new combinations of rules and immersive environments.

Therefore, in order to provide more support to these two processes within serious games, there is a motivation to invest research effort into incorporating creativity support in serious games for professional learning.

1.2.2 Creating playfully

Play as a means of thinking creatively to generate outcomes that are both novel and useful has been recognized for many years.

One often experiences the creative process as a form of play, because creative solutions are not accomplished by intellect alone, but by the play instinct [154]. Playing with ideas, trying out possibilities, breaking the usual patterns of thought – these can all be supported by a game [95].

Many creativity techniques, available for use in creative problem solving techniques, already have elements of play [129], such as contingency, inter-subjectivity and emergence [162] (see Section 2.2.4 for definitions), suggesting an appreciation of play in CPS. So, could creativity techniques benefit, in terms of amplified outcomes, from the more structured game mechanics, a game environment and game contents that come from game design frameworks and practices? Creative approaches to problem solving could be intentionally integrated, not only implicitly by designing an enabling game environment, but also explicitly by facilitation of the creative process in games (i.e. the creative process that is structured, customised and lead by a facilitating agent or a resource). These approaches to problem solving could present a new context for play for creative thinking – one that can innovatively drive technology-led changes to the facilitation of creative thinking and pose a new genre in serious gaming for motivated learning.

1.3 Research questions

This doctoral research integrates creativity support into game design intended for motivated learning, thereby establishing one novel form of connection between the fields of CPS and SGs. My

initial framework proposal extends and integrates several game models and frameworks with creativity and learning support (see Section 2.1), employing my understanding of the intersections between these fields. The framework is called the Creative Game-based Learning (CGBL) framework, and the game prototype instances of it – Creative Serious Games (CSGs).

The desired positive outcome of playing a CSG would consist of: i) achieving creative learning outcomes: emergent creative outcomes (i.e. generated ideas), acquisition of creative thinking skills, and domain-specific motivational and learning benefits; ii) experiencing aesthetics of: joy, trust, anticipation and surprise (defined in Chapter 3). I consider achieving at least one creative learning outcome and experiencing of at least one of the CGBL aesthetics to be the threshold of the positive CSG outcome.

With the positive CSG outcome in mind, my design and development efforts focused on the most effective game mechanics, game environment, player mode, artefacts and creativity techniques (defined in Chapter 4).

In effect, the following research questions were posed:

- *RQ1*: What are the shared and non-shared characteristics of creativity support and good game design?
- *RQ2*: Which game mechanics, game environment, player mode, artefacts and creativity techniques are the most appropriate to employ in a creative serious game (CSG)

that instantiates the CGBL framework in dementia care training domain?

- *RQ3*: Does the final CSG prototype induce a positive CSG outcome, as defined by the CGBL framework?

1.4 Research objectives

The research objectives were to:

- *OBJ1*: Explore and theoretically describe the relationship between creativity and gameplay for motivated learning by proposing a domain-independent framework for creative game-based learning (CGBL);
- *OBJ2*: Design one or more customized game prototypes with integrated creativity support that instantiate the CGBL framework in the application domain of dementia care;
- *OBJ3*: Evaluate the CGBL framework with playtesting of the final CSG prototype in an empirical study of the CGBL aesthetics and creative learning outcomes.

The actions to achieve *OBJ1* are described in Chapters 3 & 5; the efforts made towards achieving *OBJ2* are described in Chapter 4; and the results of work to achieve *OBJ3* are presented in Chapter 6. Table 1-1 presents an overview of the mapping between research questions, objectives and outcomes in this project.

Objectives	Questions	Outcomes
OBJ1: Explore and theoretically describe the relationship between creativity and gameplay for motivated learning by proposing a domain-independent framework for creative game-based learning (CGBL).	RQ1: What are the shared and non-shared characteristics of creativity support and good game design?	Theoretical description of the relationship between creativity and SGs in the form of the CGBL framework.
OBJ2: Design one or more customized game prototypes with integrated creativity support that instantiate the CGBL framework in the application domain of dementia care.	RQ2: Which game mechanics, game environment, player mode, artefacts and creativity techniques are the most appropriate to employ in a creative serious game (CSG) instantiating the CGBL framework in dementia care training domain?	Design and development of game prototypes that instantiate the CGBL framework.
OBJ3: Evaluate the CGBL framework with playtesting of the final CSG prototype in an empirical study of the CGBL aesthetics and creative learning outcomes.	RQ3: Does the final CSG prototype induce a positive CSG outcome, as defined by the CGBL framework?	The partial CGBL framework validation.

Table 1-1: The overview of project's research design, where the research questions, objectives and outcomes are mapped.

The actions to achieve *OBJ1* are described in Chapters 3 & 5; the efforts made towards achieving *OBJ2* are described in Chapter 4; and the results of work to achieve *OBJ3* are presented in Chapter 6. Table 1-1 presents an overview of the mapping between research questions, objectives and outcomes in this project.

1.5 Research design

The following sections provide an overview of the research design activities (Table 1-2) that addressed the individual objectives and research questions of the doctoral project. The Research Ethics Committee of City University London approved the MIRROR project research activities, including this doctoral research.

Activities	Objectives & questions	Timeline
Framework development	OB1 / RQ1	Oct 2011-Jun 2012
Formative evaluations	OBJ2 / RQ2	Jul 2012-Feb 2014
Updated framework version		
Summative evaluation	OBJ3 / RQ3	Mar-May 2014
Updated framework version, design recommendations & exploitation routes resulting from the framework application		Jun-Sept 2014

Table 1-2: Mapping of the research activities. For reference on research questions and objectives, please see Sections 1.3 & 1.4, respectively.

1.5.1 Theoretical description of the relationship between CPS and SGs

To achieve *OBJ1* (see Section 1.4) and investigate *RQ1* (see Section 1.3), in the period October 2011-June 2012, I undertook a

literature review that identified mappings between the dimensions of a creative climate and good game design principles [171]. A creative climate is an environment that promotes creative behaviour [89]. The review revealed shared characteristics between creativity and game play that included: challenge, freedom, trust and safety, humour and playfulness, persistence and idea-support; whilst conflict is a non-shared characteristic (defined in Chapter 3). These characteristics provided insight about what a good CSG user experience should be.

The CGBL framework was further informed by the state-of-the-art reports on both SGs and CPS practices (see Chapter 2), to define connections in actions, inputs and outputs. This led to the identification of mechanics, dynamics and aesthetics that are the most appropriate for creative learning (see Chapter 3). The terms of game mechanics (i.e. the particular components of the game, at the level of data representation and algorithms), dynamics (i.e. the run-time behavior of the mechanics acting on player inputs and each other outputs over time) and aesthetics (i.e. the desirable emotional responses evoked in the player, when one interacts with the game system) were inherited from the MDA (Mechanics-Dynamics-Aesthetics) framework [86], and expanded with the CGBL-specific principles. The framework development was further informed by the undertaken design and development iterations and resulting design recommendations (see Chapters 4 and 5).

1.5.2 Design and development of game prototypes that instantiate the CGBL framework

To achieve *OBJ2* (see Section 1.3) and investigate *RQ2* (see Section 1.4), I iteratively undertook two interventions, in the period July 2012-February 2014:

- The creation of mechanics and dynamics that instantiated the initial CGBL framework proposal, combined with consultations with experts from fields of SGs design, creativity and dementia care;
- Users playtesting game prototypes in real-life environment, from conceptual to physical paper-based versions [172], to digital environments as the final outcome that led to achieving *OBJ3*. The CGBL framework was used to guide design decisions (see Chapter 4).

1.5.3 The partial CGBL framework validation

OBJ3 was achieved by analysing data collected during the playtesting of the final, most advanced prototype in the period March-May 2014. With the intention to validate the CGBL framework, which was modified after formative evaluations, I assessed:

- The immediate creative outcomes by having ideas generated in gameplay rated by domain experts with respect to novelty, usefulness and person-centredness;
- The effect that the mechanics and dynamics of the CGBL framework implemented into the prototype design have on subjects' player experience, in terms of player engagement and aesthetics predicted by the CGBL framework.

1.6 Research contribution

The first research contribution of the project is a **theoretical framework** to inform the design of a new form of serious games that explicitly support players' creativity. This framework provides recommendations on how to design new games to deliver creativity training [171]. Other researchers and designers are encouraged to adopt and validate it through development of their own creative serious games.

The second main contribution is the **design and evaluation of a creative serious game prototype consistent with the framework** to train carers to use more investigative and creative thinking in their work [172] – a user group that is often neglected in dementia-related games research [122]. This project has revealed the potential of computer-supported creative serious games in person-centred residential care. Although sensor-based technologies have been successfully implemented in residential care settings [114], new forms of interaction that will encourage

carers to engage in the creative process in a gamified environment is a new development in residential care support. Finally, this research demonstrated that a serious game could be used to train people in creative thinking – a skill increasingly recognized as important in sectors such as healthcare. In this regard, the use of new digital technologies such as sensors for embodied interaction was important, both to deliver a seamless game experience and to trigger emotions such as *trust* and *surprise* that are associated with creative thinking and engagement.

This doctoral project focused its contribution to three fields:

1. *Creative problem solving*: The CSGs offer an opportunity to facilitate (i.e. lead, mediate) CPS in a novel way. The existing playful elements in creativity techniques can be further gamified in order to systematically support creative thinking. To this end, the CGBL framework I propose in this thesis theoretically extended the application of: one creative process model (see Section 2.2.1.4); the theory of creative climate requirements (see Section 3.1); creativity techniques (see Chapter 4); creative learning (Section 2.2.3); and creativity and play theories (Section 2.2.4); - within a previously unexplored context (i.e. SG design) from the point of view of explicit creativity support. Creativity researchers and practitioners can benefit also from my empirical experiences with facilitating CPS using a CSG within one challenging problem domain (i.e. person-centred dementia care).

2. *Serious Games*: Arguing for a new type of SG that explicitly supports creativity is a valuable addition to the state-of-the-art in serious game design, as suggested by my formative and summative CSG prototype evaluation results in the domain of dementia care staff training. Lessons learned through my game design work can be valuable to others interested in designing CSGs. New instances of CSGs can be developed for other application domains that would benefit from creative problem solving in professional training. Moreover, the intention is that, in future work, the CGBL framework could be subjected to other instantiations of its components depending on new technologies, to provide opportunities for further validation of the framework and innovative technology-supported CGBL components, and in effect, CSGs that respond to the numerous modern challenges of motivated learning.

3. *Person-centred dementia care*: With this project, I contributed to the application domain of dementia care by innovatively supporting training in person-centred care and the positive creative climate change in the sector [107, 128]. In particular, my intention was to:

- Create opportunities for new engagements between the stakeholders, by introducing new sensory experiences using a technology-supported game environment;
- Employ creativity techniques to open up space within care work activities to be reflective, and to support emotional care planning;

- Use game as a training tool to open up innovative ways of communicating, encourage curiosity and appreciative enquiry, and in effect provide a context for positive creative climate changes.

These arguments will be discussed in more detail in Chapter 7, in the context of accomplished results, state-of-the-art related works and potential exploitation routes.

1.7 Structure of the thesis

The structure of the thesis is as follows.

This chapter introduces the reader to the motivation that inspired the project and the initially identified opportunities for intervention (see Section 1.2), the research questions (see Section 1.3), the research objectives (see Section 1.4), an overview of research design (see Section 1.5) and the research contribution (see Section 1.6).

Chapter 2 puts this research in the context of the state-of-the-art theories and practices of serious games (see Section 2.1), creativity science (see Section 2.2) and the application domain of dementia care (see Section 2.3), using critical literature review methods that analyze the relevant background research and identify knowledge gaps and opportunities for intervention.

Chapter 3 describes and justifies the preliminary version of the theoretical contribution of the Creative Game-based Learning

(CGBL) framework that this research has generated, by introducing the underlying literature mapping I created between creative climate and good game design principles (see Section 3.1) and detailed explanation and rationale of the main framework components (see Section 3.2).

Chapter 4 reports on the series of formative evaluations conducted in the iterative process of design and development of CSGs that instantiate the CGBL framework in the chosen application domain of dementia care, as well as the impact of these evaluations on understanding and refining of the CGBL framework.

Chapter 5 reports on the final version of the CGBL framework, where the dependencies between the components (i.e. aesthetics, dynamics, mechanics) and relationships between the stakeholders are refined using the lessons learned through design and development of CSG prototypes, resulting in ten methodological guidelines for the CGBL framework instantiation.

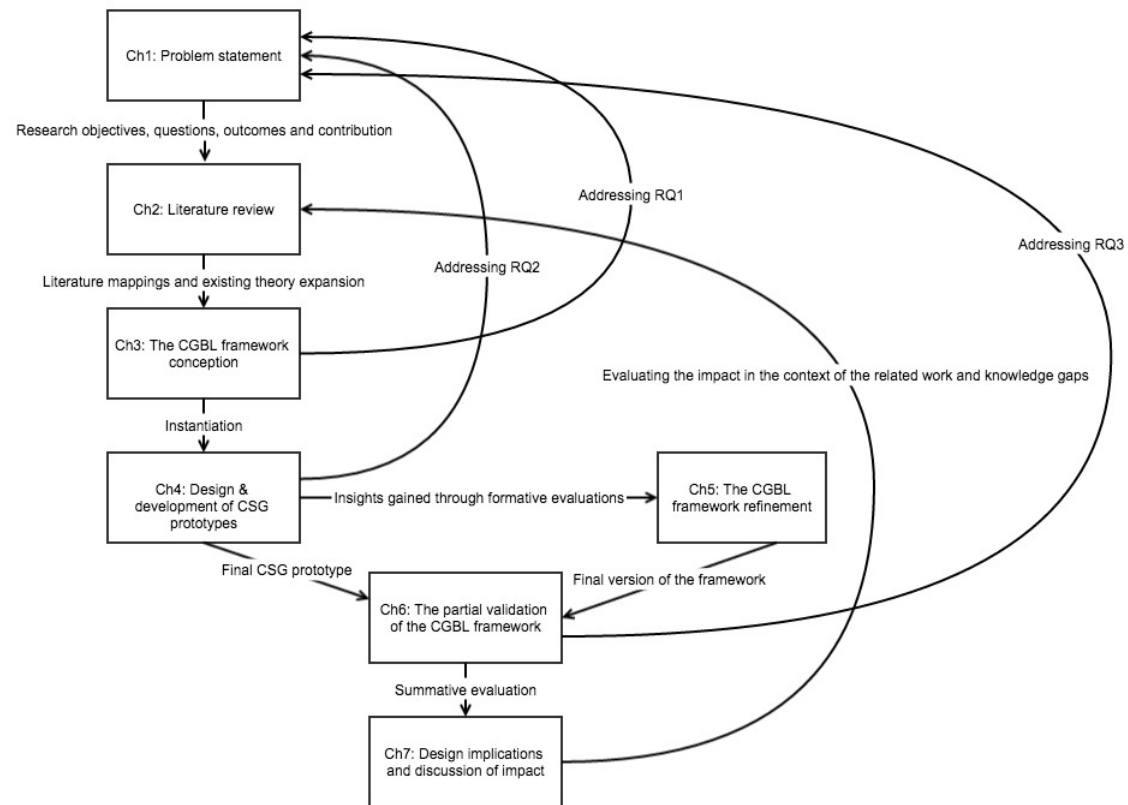
Chapter 6 reports on the qualitative summative evaluation of the final prototype application in order to achieve the third research objective regarding framework's validation. The CGBL framework's effectiveness is partially evaluated by assessment of the experienced game aesthetics and engagement. The study's conditions, results and implications are explored.

Finally, Chapter 7 discusses the outcomes and contribution of the study in the context of proposed objectives and research questions, as well as research studies' exploitation routes, design

recommendations, impact of the results and challenges for future work.

The structure of the thesis is presented in flow diagram form in Figure 1-2.

Figure 1-2: Flow diagram of the thesis structure by chapters.



1.8 The chapter summary

The first section of this chapter introduces the problem statement: how to integrate creativity support into serious games, in particular, games for motivated learning for professional training? Next, Section 1.2 provides an insight on the context and motivation of this research project, as well as the two main identified challenges of interest to the investigation: how to play more creatively, and how to create more playfully.

Then, in Section 1.3 I outlined the three research questions (*RQ1*, *RQ2*, *RQ3*): i) What are the shared and non-shared characteristics of creativity support and good game design?; ii) Which game mechanics, game environment, player mode, artefacts and creativity techniques are the most appropriate to employ in a creative serious game (CSG) instantiating CGBL framework in dementia care training domain, in terms of players' reactions to particular design choices?; iii) Does the final CSG prototype, designed to instantiate the CGBL mechanics and dynamics, induce a positive CSG outcome, as defined by the CGBL framework?

In the fourth section I defined the project's three objectives (*OBJ1*, *OBJ2*, *OBJ3*) that are related to the posed research questions: i) Explore and theoretically describe the relationship between creativity and gameplay for motivated learning by proposing a domain-independent framework for creative game-based learning (CGBL) (*RQ1*); ii) Design one or more customized game prototypes with integrated creativity support that

instantiate the CGBL framework in the application domain of dementia care (*RQ2*); iii) Evaluate the CGBL framework with playtesting of the final CSG prototype in an empirical study of the CGBL aesthetics and creative learning outcomes (*RQ3*).

Section 1.5 provided an overview of the research design, that lead to three main outcomes: Creative Game-Based Learning (CGBL) framework conception; design and development of its instances, creative serious games (CSGs); the partial validation of the CGBL framework.

Section 1.6 discussed the three main lines of the project's contribution to the knowledge: creative problem solving (i.e. new mode of CPS facilitation), serious games (i.e. guidelines on how to make games for motivated learning that incorporate explicit creativity support) and person-centred dementia care (i.e. new mode of care staff training).

Finally, in Section 1.7 the structure of the thesis was explained.

Chapter 2 – Literature Review

This chapter details my critical review of the relevant literature. It consists of three sections that address the targeted research contribution in three fields: i) serious games; ii) creative problem solving; iii) person-centred dementia care. Each section firstly provides a reader with the necessary definitions and background research, and then discusses the state-of-the-art theories, practices and the knowledge gaps that influenced the research objectives, questions and methods. In particular, this literature review has informed the CGBL framework conception, and design and development of my prototypes.

2.1 Serious games

This section is organised as follows: in the first subsection I introduce the serious games' definitions and background research relevant for this project. In the second subsection, I analyse three concepts of interest that I identified in the critical review of the state-of-the-art of serious games, and explain the opportunities they provide for an academic contribution.

2.1.1 Definitions and background research

Serious games are seen as a branch of the creative industries that can foster innovation on micro-, meso- and macro-levels [119]. A game differs from play by having the following clearly defined features: game space, boundaries, rules for interaction, artefacts and goal [62, 153]. For example, in the game of chess, the game space is defined by the chess board that is 8x8 (i.e. boundaries), it is played with 32 light and dark figures (i.e. artefacts), by two

players who follow a set of interaction rules of board movement, competition and conduct, with a goal to win by eliminating opponents' figures. In contrast, play is more open-ended, involves activities such as make-believe and world-building [162], and often is connected with children's development, whilst a game is has the aforementioned structure.

Serious games are a subset of games. In this work, I use the following definition of serious games:

“Serious games are games for social change, development and motivated learning that are “in any form of interactive computer-based software for one or multiple players to be used on any platform”, which “have been designed to have benefits other than entertainment” [153, p.6].

Utilizing games by designing applications for such effects in non-game application domains is a process known as gamification [48], and it has received significantly encouraging research reports in recent years [59, 98, 145, 153, 180]. Gamification has achieved widespread results, for example to train marine staff [14], treat cockroach phobia [23], overcome negative emotions [181], manage large-scale investment resources [87], rediscover cultural heritage [70] and help cancer patients make decisions about their health [111].

One of the most famous and successful early examples of gamification of the learning process is a geography video game *Where in the World is Carmen Sandiego?* (1990) [53] (Figure 2-1), which was well accepted by all stakeholders: children, parents

and schoolteachers. It employed game mechanics to teach young school children about the world’s major capitals and sights, which is by default a non-game domain. Usage of this game in the classroom contributed directly to the curriculum delivery, with encouraging results in student engagement and knowledge acquisition [53].

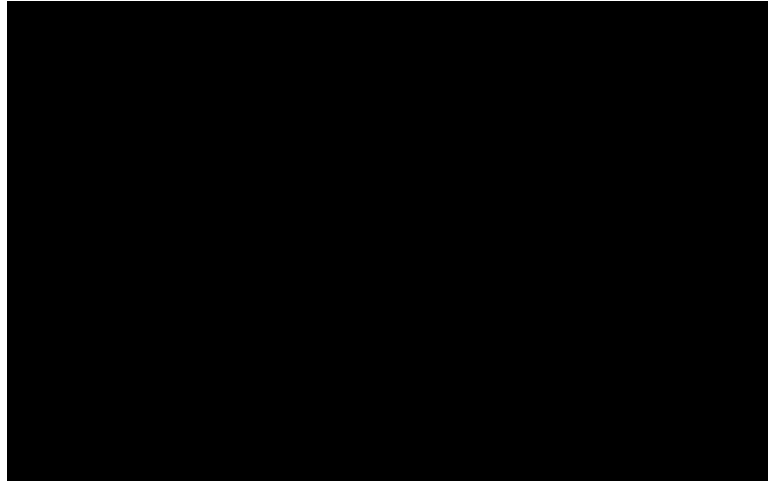


Figure 2-1: Screenshot from the popular ‘90s serious game “*Where in the World is Carmen Sandiego?*”.

Still, however, as Bateson observes in one of his famous metalogues in the book *Steps to an Ecology of Mind* (1972) [15], “serious game” is a confusing term – if it is a game, how could it be serious, or if it is something serious, how could it be a game? The literature review presented in the following sections illustrates that a game can still be engaging, even if a game designer aims at player benefits other than playing for playing’s sake. But what obstacles to players achieving such game play objectives can we observe in the literature, in particular in the context of motivated learning?

2.1.1.1 Engagement in games for motivated learning

According to [200], the power of gamification lies in the engagement and loyalty of players to the process of game play, where ideally, the players are in the zone of “flow” between boredom and anxiety [43]. In creating games for motivated learning, which are sometimes also referred to as “edutainment” [153] – the educational element, although important and necessary, often overshadows the engagement element [76, 90]. One recent attempt to bridge these two requirements is the Learning Mechanics-Game Mechanics (LM-GM) model [7] that supports designers in creating games with both pedagogical and entertainment features.

One way to achieve engagement is by explicitly designing for fun. In [109], four kinds of fun are outlined: i) hard fun, where a player is trying to win some form of competition; ii) easy fun, where a player is focused on exploring the system; iii) altered state fun, in which the game changes the way the player feels, and; iv) social fun, during which the player engages with other players. These definitions are useful, but according to [153], more systematic research is still needed in the future in order to define their implementation guidelines in the edutainment context.

Another approach to engagement enhancement is explicitly designing for reinforcement. Reinforcement theory studies how one could convert an expected reward into player action by varying the quantity and delivery schedule of that reward [153]. A straightforward example would be giving points or badges for correct answers to instructional content questions. Many authors

agree that one has to be careful with the application of this paradigm, as for the serious games to be successful, the educational component has to be enjoyable in its own right, and reinforcement should not be the only player's motivation to learn and engage [153]. Therefore, a serious game has to be designed to also provide intrinsic motivation [200], especially for the application domains where impact is not limited on knowledge acquisition or skills practice, but includes problem solving, exploration and incidental learning [170].

Immersion in games in general was studied by Jennet et al. (2008) [90] who extracted five contributing dimensions by principal component analysis of a games database sample: cognitive involvement (curiosity, interest); real-world dissociation; challenge; emotional involvement (empathy, enjoyment); and control (interacting with a game). In a similar study, three dimensions were identified: i) sensory immersion (sounds, visualisations); ii) challenge-based immersion (challenge, abilities), and; iii) imaginative immersion (empathy, fantasy) [57]. Sherry et al. (2006) [167] identified six player motivation types: competition; challenge; social interaction; diversion; fantasy; and arousal. Takatelo's Presence-Involvement-Flow model [186] is used to evaluate these immersion, engagement and motivation factors in the context of player experience, helping game designers to iteratively improve the effectiveness of serious games and understand the players they design for. Implementing customized immersion triggers in games, such as facilitation of social interaction, could bring the players closer to the state of flow [200], and help them to engage more meaningfully with the educational input. Therefore, in my CSG design and development

work within this doctoral project, the player engagement was given careful consideration.

2.1.1.2 *Player types*

Bartle (1996) established a categorization of players that specified four main types [13, p.1]: Achievers (“players who prefer to gain points levels, equipment and other concrete measurements of succeeding in a game”), Explorers (“players who prefer discovering areas, creating maps and learning about hidden places, often feeling restricted when a game expects them to move on within a certain time, as that does not allow them to look around at their own pace”), Socializers (“players who gain the most enjoyment from a game by interacting with other players, and on some occasions, computer-controlled characters with personality”) and Killers (“players who thrive on competition with other players, and prefer fighting them to scripted computer-controlled opponents”) (Figure 2-2).

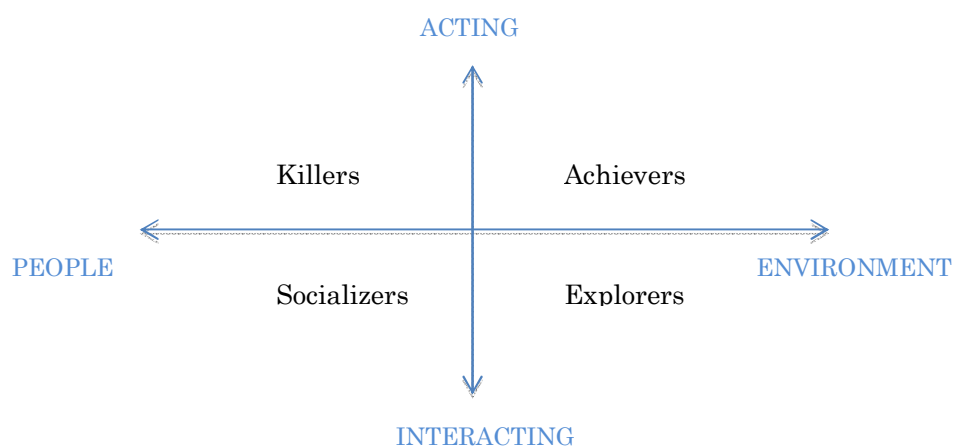


Figure 2-2: Bartle’s main player types, adapted from [13].

Most people are not one type or the other, but a mixture of types. If Bartle's categories were mutually exclusive, one study determined that the majority of people, as much as 75% - would be socializers [200]. The work on categorization was expanded in 2003 [12, p.3] by introducing subcategories: Friend, Griever, Hacker, Networker, Opportunist, Planner, Politician, and Scientist. Whilst the Opportunist (implicit Achievers, "if they see a chance, they take it; look around for things to do, but they don't know what these are until they find them; if there's an obstacle, they do something else instead; flit about from idea to idea like a butterfly"), and Scientist (explicit Explorers, "experiment to form theories; use these theories predictively to test them; methodical in their acquisition of knowledge; seek to explain phenomena") do have some creative problem solving activities in their preference, in my understanding, none of these terms seem to explicitly recognize the player's need to create within a game. Opportunists and Scientists apply different techniques to explore and manage the input provided by the game contents. However, they do not seem to have been given opportunities by game design to contribute input and bend the game's rule space. Allowing the creation of artefacts within the game and expansion of the game rules beyond implemented boundaries would provide new context for interplayer and game-player interaction.

In the next subsections I discuss the key serious games models and frameworks that influenced the construction of the CGBL framework that I am proposing in this work (see Chapters 3 and 5).

2.1.1.3 *Classifying serious games*

Ratan & Ritterfeld (2009) [150] developed a classification system of serious games (Table 2-1) based on an iterative examination of a dataset of about 600 serious games, and defined four distinctive dimensions of SGs: i) primary educational content; ii) primary learning principles; iii) target user age group; iv) game platform. The primary educational content is defined as the element that makes a game serious, and not just for entertainment purposes. The primary learning principles explain how the educational content is delivered in a game. The game platform indicates whether a game was designed to be played on a PC computer or other device(s).

Dimensions of serious games' properties, used for classification	<i>Primary educational content</i>	Academic education (63%)
		Social change (14%)
		Occupation (9%)
		Health (8%)
		Military (5%)
		Marketing (<1%)
	<i>Primary learning principles</i>	Practicing skills (48%)
		Knowledge gain through exploration (24%)
		Cognitive problem solving (21%)
		Social problem solving (7%)
	<i>Target user age group</i>	Preschool and below (5%)
		Elementary school (39%)
		Middle school and high school (39%)
		College, senior and adults (16%)
	<i>Game platform</i>	PC (90%)
		Non-PC: DVD, Nintendo DS and Playstation (10%)

Table 2-1: Classification of serious games by Ratan & Ritterfeld (2009), adapted from [150].

In contrast, this doctoral research increases the diversity of serious games, and the establishment and investigation of the less represented subcategories of serious games according to this categorisation. The CGBL framework developed in my research focuses on games designed primarily for (but including elements of other categories): occupational skills as educational content, social problem solving as a learning principle, adults as the target age group and non-PC game platforms.

2.1.1.4 *Understanding game play: the IPO model*

Several authors have developed descriptive models of motivated user behavior during the playing of serious games [78, 101, 194, 198]. One such model from Garriss et al. (2002) [66] proposes a theory that games should enable and allow the user to choose to enter them to accomplish a goal or overcome a problem, and describes the experience in Input-Process-Outcome (IPO) form (Figure 2-3).

The input components of a serious game according to this model are the instructional content and game characteristics. Game characteristics include [66, p.447]: Fantasy (“Imaginary or fantasy context, themes, or characters”); Goals (“Clear rules, goals, and feedback on progress toward goals”); Sensory stimuli (“Dramatic or novel visual and auditory stimuli”); Challenge (“Optimal level of difficulty and uncertain goal attainment”); Mystery (“Optimal level of informational complexity”); Control (“Active learner control”). These characteristics resulted from a literature review by Garriss et al., relating them with the

instructional content for the first time. This model puts an equal emphasis on educational and game features when triggering a game cycle, and the benefits of doing so have been discussed earlier in this section (see Section 2.1.1.1).

In combination with the IPO model, instructional content and game characteristics trigger a *game cycle* that aims to support intrinsic, self-motivation. This type of motivation is preferred in the IPO model, and in general in the tradition of motivated learning [153]. Such game play involves repeated judgment-behavior-feedback loops that are triggered by instructional content and game characteristics, where user reactions lead to behaviours, which in turn lead to system feedback that affects the user judgement [66], with an aim of raising the overall levels of user engagement.

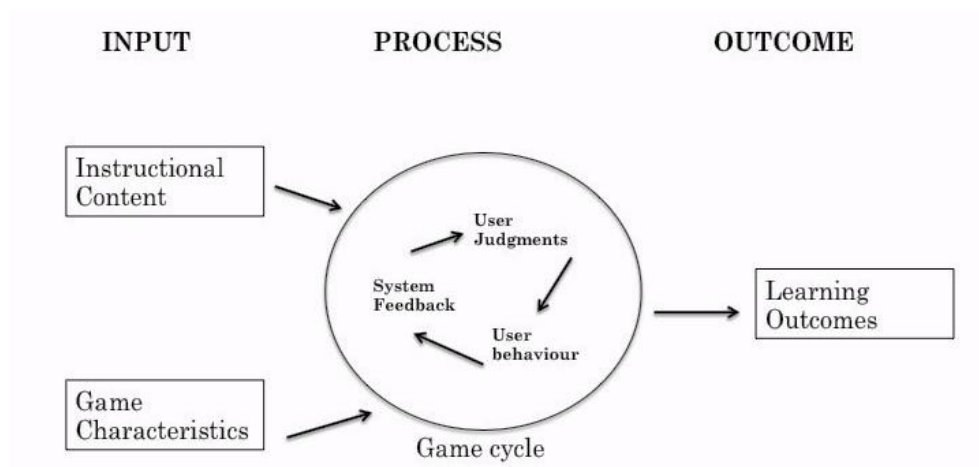


Figure 2-3: The IPO model [66], describing the motivational learning game play process construct.

Depending on the nature and requirements of the instructional content, the *output learning outcomes* of this game cycle could be

[66, p.455]: Skill-based (“Performance of technical or motor skills”); Cognitive-declarative (“Knowledge of the facts and data required for task performance”); Cognitive-procedural (“Knowledge about how to perform a task”); Cognitive-strategic (“Ability to apply rules and strategies to general, distal, or novel cases”); Affective (“Beliefs or attitudes regarding an object or activity”). These outcomes expand the primary educational content categories Ratan et al. [150] identified in their classification of serious games. As cognitive-strategic and affective outcomes are of large importance as objectives of creative learning in an occupational context [20, 125], they have been addressed by the CGBL framework by systematically supporting the acquisition of these creative skills.

Garris et al. in their work also discuss the importance of debriefing and scaffolding knowledge as part of the game cycle, how these link to the learning outcomes, allowing one to “to transform game events into learning experiences”, because “it is unrealistic to expect even the most self-directed learners to construct knowledge on their own”, and thus, “learning by doing must be coupled with the opportunity to reflect and abstract relevant information” [66, p.455]. This idea has a significant relevance to my research, as I looked at the role of the reflection and transformational creativity techniques in generating learning and creative outcomes (see Chapter 4).

There are several other reasons for choosing the IPO model as a guiding perspective on game play in the conception of the CGBL framework. While supporting tacit learning (active knowledge construction from experience [103]), it also recognizes the role of

facilitation and game components as a missing piece in experiential learning [121]. The game play process puts emphasis on engagement in serious games in a way that adapts game features for instructional purposes, where the game cycle “sustains self-directed interest, without squeezing out what is enjoyable about games in the first place” [66, p.459]. Finally, this model is useful because it joins together the principles of other established models and theories [78, 194, 198] that exist about its separate components (game features, user behavior, learning outcomes).

2.1.1.5 Understanding game design: the MDA framework

In order to put the CGBL framework in the context of game design, I studied the MDA framework by Hunicke et al. (2004) [86], which is a descriptive theory that bridges the gap between game development (how the game is designed) and game player experience (how the game is perceived). The MDA framework formalizes the consumption of games by breaking them into their distinct components: Rules, System and Fun; and defining their design counterpart: Mechanics, Dynamics and Aesthetics (Figure 2-4).

The mechanics are the particular components of the game, at the level of data representation and algorithms. The dynamics refer to the run-time behavior of the mechanics acting on player inputs and each others' outputs over time. Aesthetics describe the desirable emotional responses evoked in the player, when one

interacts with the game system. To illustrate the MDA components, let us analyse the popular detective boardgame game of *Cluedo*, where in order to solve the murder of Mr Black, it is required to find out who the murderer is among his party's guests, what the murder weapon was, and in which room the murder was committed. This game has the aesthetics of Fellowship ("game as social framework"), Discovery ("game as uncharted territory"), Fantasy ("game as make-believe") and Challenge ("game as obstacle course") [86]. Its dynamics to achieve these aesthetics are exchanging information, a winning condition that could not be achieved alone, board exploration, playing in the role of characters, clue gathering and dramatic tension. In order to evoke these dynamics in *Cluedo*, the implemented mechanics include the board, the pawns, the cards, dice, the weapon objects, the characters, and a rule set that encourages the multiplayer player mode, competition and exploration.

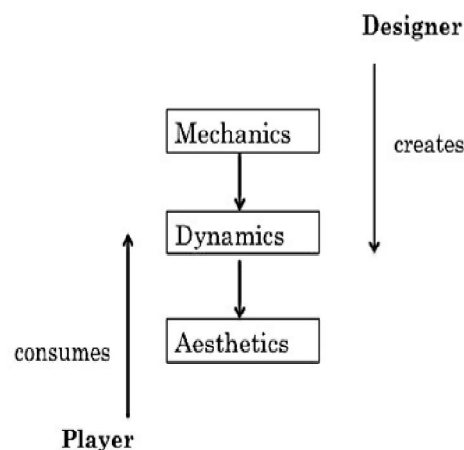


Figure 2-4: The MDA model [86] bridges the gap between game design and game experience.

Game designers design the structures and context (i.e. mechanics and dynamics) in which play happens – indirectly shaping player experience – by creating opportunities for future action to occur [159]. The MDA framework focuses on the game’s functioning (i.e. mechanics and dynamics) rather than representation (i.e. aesthetics) [113, 121], stressing that, fundamentally, games are more like artefacts than media. The framework emphasizes that games are designed systems that build behaviour through interaction [86]. It views digital games as artefacts created within an iterative design methodology, and therefore uses the same approach to analyse them.

The MDA framework has often been used as a game design baseline theory in other frameworks. One example is Takatalo’s representation of the game elements as mechanics, play elements as dynamics and psychology elements as aesthetics (Figure 2-5) [186]. In the work by Mitgutsch et al. (2012) [130], the MDA framework was used as a baseline for the SGDA framework, used for serious games assessment. In [113], an adapted version of the MDA framework is used to evaluate the UX in game case studies. Building the CGBL framework, my focus was on defining the most appropriate instantiation of mechanics, dynamics and aesthetics, with regards to MDA framework, to encourage creative thinking and the user behavior needed to demonstrate creative thinking in game play.

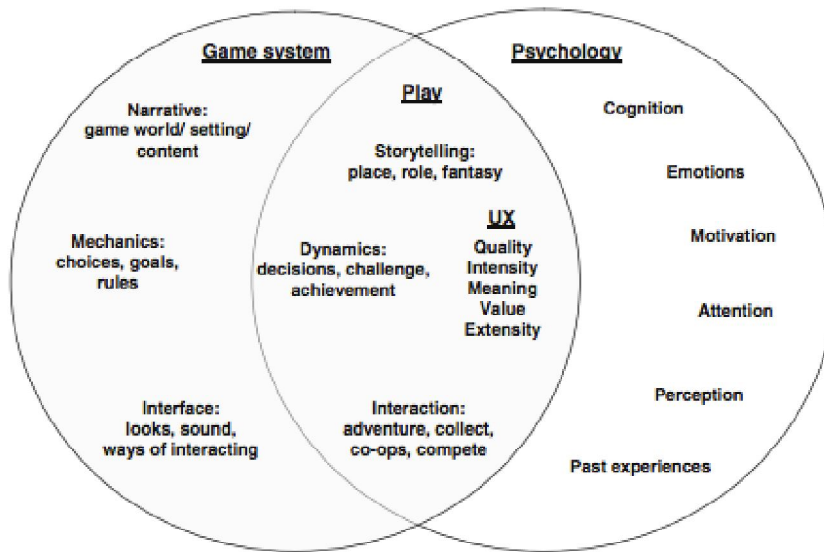


Figure 2-5: Takatalo's adaptation of the MDA framework: game system is affected by the game designer (i.e. mechanics), play is when the user interacts with a game (i.e. dynamics), whilst the UX characteristics instantiation are affected by user background and psychology (i.e. aesthetics).

2.1.1.6 Understanding game mechanics: the AddingPlay toolkit

Although what actually constitutes mechanics is contested by game scholars and designers alike [48, 66, 159, 186]; the MDA framework considers them to be “the various actions, behaviours, and control mechanisms afforded to the player within a game context” [86, p.3]. When analysing a game the game designer can work backwards from a particular aesthetic, to the dynamics that created it, to the mechanics that support that dynamic [113].

There are commercial tools that assist game designers in brainstorming the mechanics and dynamics of a game. The serious game developer company *Playgen* developed the

AddingPlay consultancy toolkit in 2012 [2], as a commercial serious card game for making games, based on the company's extensive experience in the serious game industry. It is used to brainstorm and explore game mechanics, social mechanics, player motivation and victory conditions, and eventually decide on a gamification solution for a chosen application domain in terms of brands, products, services and websites. Player motivation cards provide options for designing for engagement, and lead the game designer to define the main reasons one would have to play the game. Victory condition cards describe the conditions for how the player succeeds and what the overall goal is. Game mechanics cards elaborate the play processes, whilst social game mechanics provide between-player interaction. In the development of the CGBL framework, I used the *AddingPlay* toolkit to define all of the CGBL mechanics. In comparison with some scholarly established frameworks for game mechanics analysis [59, 66, 78, 159, 200], the *AddingPlay* toolkit, whilst compatible, is more simple, easy to learn and use, and the card format is more playful itself.

2.1.2 State-of-the-art of serious games

One recent series of studies [45] investigated methodologies for game-based learning in professional practice for empowerment and social inclusion. It reported that good serious game design considers adults' learning as goal-oriented, and that a serious game should clearly communicate the achievement of the learning objectives. Furthermore, time and other resources play important roles in this experience, which also has to be culturally adaptable

to different countries, different ages and technologies. Their research also looks at the use of 3D games in training, and lists the possible reasons for the relatively low acceptance rate of this technique as design challenges – reasons such as utilization of immersion [57, 90], and adaptability for the given training task [189]. Whilst 20th century education focused on teaching basic skills, such as reading, writing, and calculating – 21st century education focuses on developing higher order skills, like critical thinking, collaboration, adaptability, strategizing and problem solving [28].

So what are the new frontiers for the theory and practice in the field, which bring us closer to “creating meaning” in games? In the next subsections, I will discuss three state-of-the-art concepts identified in the process of my literature review, that influence serious games design in terms of contents, outputs and technology.

2.1.2.1 Contents

Ichiro Lambe is the author of the online game *Elegy for a Dead World* (2014), where a player’s only objective is to write a story based on personal experience, while exploring the worlds of the British romantic poets Shelly, Byron and Keats (Figure 2-6a). Lambe says in an interview for *New Scientist* website [81]: “*The Holy Grail of storytelling is not telling a story but co-creating a story with a player, and that’s not something I’d seen before in games*”.

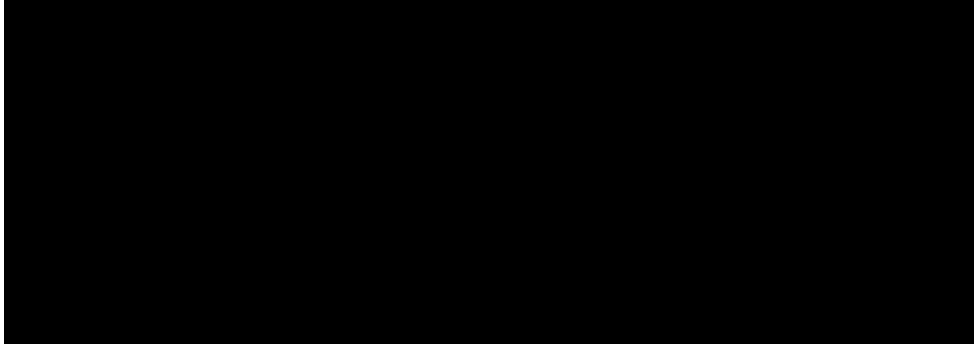


Figure 2-6: Screenshots from: a) *Elegy for a Dead World* (right); b) *Fallen London*, game developed on *StoryNexus* platform (left).

Another example of this emerging trend is StoryNexus [151], an interactive story creation open-source platform released by London-based game company Failbetter in 2012 (Figure 2-6b). StoryNexus allows users to create rich storygames through an accessible point-and-click interface, and these works can then be shared and even sold online. It proved to be a big success, with indie user-made games ranging in topics from exploring India in 1757 to biology. On the same co-creation point, [74] studied games orchestration (i.e. where a person, other than a player, is given power by designers to influence the game dynamics, in real-time). Their research identified five behavioural patterns adopted by orchestrators (*Helicopter parent*, *Guardian angel*, *Architect*, *Micro-manager*, *Villain*), and four styles of collaborative interaction between orchestrators and players (*orchestrator-dominant*, *guided*, *team*, *player-dominant*), in playtesting sessions on Tabula Rasa. Tabula Rasa is the authors' novel game orchestration tool based on a tabletop interface, where players can create game narratives and settings as the game is being played. Studying game orchestration presents an opportunity to more actively involve players in the creation and execution of game

mechanics and contents. Inspired by this discourse, I regard co-storytelling as, a form of creative process, and a valuable new direction for creating meaning in games. Therefore I sought to implement it in my own designs in this project.

2.1.2.2 *Outcomes*

By the end of 2014, Gartner predicted that over 70% of the top 2000 global companies will have deployed at least one type of gamified application to engage with their employees [68]. Google already has an internal gamified application that motivates employees to lower travel costs, and Nike uses gamification to assist employees in scenario planning in sustainable design operations [148]. This trend signals that serious games are now not only used for simulations that provide safe environments for professional practice, but also have become tools for real-time business contributions, making the player experience far more active.

Gamification has arrived in academic research centres too. There was a successful collaboration at Heriot-Watt University [29], in which researchers of interactive storytelling helped quantum physics researchers solve expert problems using as a tool a game anyone can play. They recognized that humans have predispositions, such as geo-spatial intuition, which could be utilized for reducing the search space in some optimisation problems in quantum information management that are currently solved with brute force computing approaches. The developed game allowed non-experts to generate these complex solutions in

an enjoyable way. I find this to be a good example of a transformational knowledge outcome, which may inspire other interdisciplinary collaborations and allow new forms of participatory outreach and outsourcing of data gathering and interpretation.

One other interesting type of game outcome is emotion. Tijs et al. (2009) [189] created the first successful emotionally adaptive game that utilizes relations between game mechanics, a player's emotional state and physiology-based emotion-data. Authors manipulated one game mechanic (i.e. speed), and found a correlation between players' self-reported emotional state and the measured physiology-based emotion data, which was expanded to a list of features that distinguished between boring, frustrating and enjoying game modes. This game acknowledges that players display a bigger variation of goals, preferences and emotional responses when playing a game than originally thought, which presents a considerable challenge for emotionally adaptive game dynamics in real time.

With these examples, I wanted to illustrate innovative ways to create meaning in serious games, by: i) giving players new kinds of ownership over the game outputs, on the example of quantum physics researchers benefiting from the outcomes of non-experts playing a game; ii) allowing new purposes and ways of generating those outputs, on the example of emotionally adaptive games that rely on the game play outcomes.

2.1.2.3 *Technology*

One of the most innovative pieces of technology for the classroom is *Smallab* [174], which stands for ‘situated multimedia art learning lab’, a system now being used in several schools and museums around the US. Created by a team led by David Birchfield, from Arizona State University, it is a 3D learning environment in a hybrid physical-digital space, which engages students to interact with and manipulate the digital learning materials in new ways (Figure 2-7a). Smallab’s initial pilots showed greater knowledge retention than when the traditional classroom tools were used [35].

EEG-based brain computer interfaces (BCIs), like EPOC and MindSet [118] (Figure 2-7b), have already gained significant popularity in the gaming industry since they were commercialised in 2009. Developers use them to track and respond to users’ affective states, such as satisfaction, boredom, frustration, confusion and focus, improving players’ experience in real-time [135]. More traditional gaming consoles such as Microsoft’s Xbox 360, Nintendo’s Wii and Sony’s PS4 include different sensors to infer users’ behavioral and physiological states through pressure grip, heartbeat, facial and voice recognition, and eye- and motion-tracking [118]. Whilst this technology could enable some exciting new game mechanics to evolve, there is still a challenge of accessibility, expense and usability in real-world edutainment settings, such as classrooms.

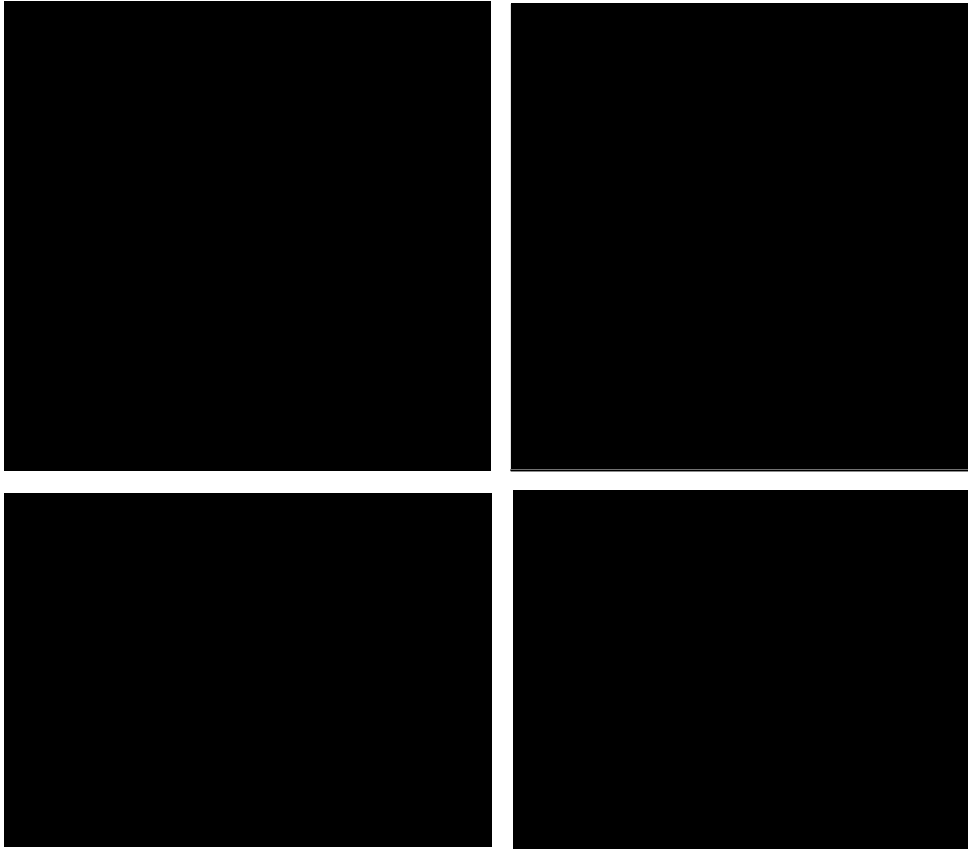


Figure 2-7: State-of-the-art games technology: a) Smallab (top left); b) EPOC (top right); c) Big Huggin' (bottom left); d).JS Joust (bottom right).

Other examples of alternative gaming interfaces include sensor technologies such as Big Huggin' (Figure 2-7c) [73] that enables player to advance through the game being displayed on the screen by giving a physical object (teddy bear) well-timed hugs; Johan Sebastian Joust (Figure 2-7d) [62] is a no-graphics digitally-supported game, where the goal is to be the last one standing in the room while trying to dance to Bach's *Brandenburg Concertos* with motion-controllers that are highly sensitive to changing thresholds; and SwimGames [46], winner of the 2014 European Serious Games Award, uses an actual technology-supported swimming pool as a videogame interface, with a goal to engage

people in recreational physical activity. These new forms of games technologies can help us have new conversations with new meanings within a serious game, but their effectiveness is still to be demonstrated further.

2.1.3 Conclusion

The state-of-the-art research and industry of serious games seems to be progressing towards: i) more non-PC, platform-independent technology solutions; ii) more active player roles in co-creating game contents and dynamics; iii) new customizable ways of generating and managing the growing variety of game outcomes. This previous research suggests that these technologies have the potential to provide players with more ways to create meanings within serious games that go beyond simulation mechanics and dynamics, towards creative problem solving and expression that expands the implemented game borders.

2.2 Creativity

This section aims to identify the definition of creativity that is the most appropriate in the context of the studies that I conducted, and to critically review the relevant background research and some of related works in the field of creativity science. The section is organised as follows: i) definitions and background research; ii) creative problem solving; iii) creative learning; iv) creativity and play, and; v) creativity assessment.

2.2.1 Definitions and background research

Creativity science has been present and developed since the early 20th century. It has shown that creativity, though complex, can be studied productively and systematically [177]; that it can be encouraged in individuals, groups and organisations [162]; that it can be explicitly supported through the application of different established techniques and frameworks [89, 96, 161], and more recently – by various computational creativity tools [168]. One published creativity science timeline illustrating these efforts is presented in Figure 2-8.

The importance of creativity studies, according to [41], lies in development of all branches of industry, not only the creative industries, and could be a key competitive feature in modern economic markets [37, 162]. Rothenberg predicted that studying creativity should be one of the priorities of the modern research, as it provides opportunities for “improvement of ourselves and the world at a time when conventional means of understanding and betterment seem outmoded and ineffective” [156, p.5]. Indeed, 2009 was “The European Year of Creativity and Innovation”, because, as stated in its manifesto, “Europe’s future depends on imagination and creativity of its people” [34, p.1].

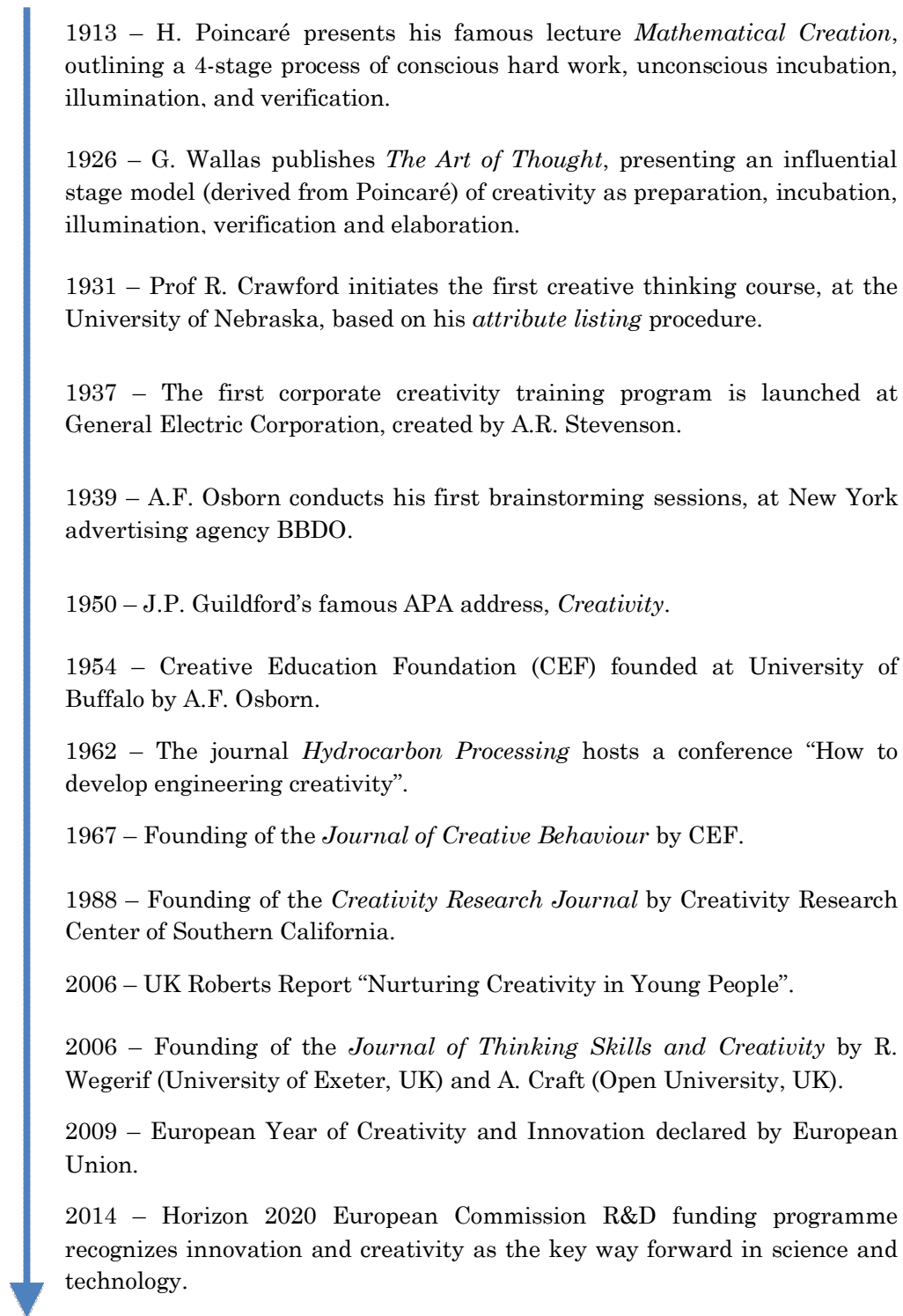


Figure 2-8: Creativity research timeline, adapted from [162].

Sawyer [162, p.5] reported on five key areas that benefit from explaining creativity:

1. *Explaining creativity can help us identify and realize every person's unique creative talents.*
2. *Explaining creativity can help our leaders to respond better to the challenges facing modern society.*
3. *Explaining creativity can help us all to be better problem solvers.*
4. *Explaining creativity can help us realize the importance of positive, peak experiences (i.e. flow) to mental health.*
5. *Explaining creativity can help educators teach more effectively.*

This research sought to contribute results towards the third and fifth areas: to find new effective techniques of creative problem solving for educational, transfer-of-knowledge purposes. In order to achieve this ambition, interdisciplinary approach was needed, because “creativity is precisely the kind of problem which eludes explanation within one discipline” [65, p.22]. The fields of serious games and person-centred dementia care offered new forms of context, tools and discourses for conducting a creativity research project. The importance of interdisciplinary investigation of creativity is further reported in [82, 177,178].

Play and Creative Problem Solving (CPS) rhetoric, which considers CPS to have originated from play, emerged in Ancient Greece [201], and was revived in Romantic period, influenced by Rousseau [176]. Creativity in a game has been described as “the ability to create, and to share one's creations” [149, p.63]; “the

opportunity for players to be creative, either through lateral thinking and creative problem-solving or through the creation of their own artifacts within the game (e.g. creating posters, video, or stories)” [195, p.146]. From that set, I find the final definition to be the most complete, and would add – artifacts that are “novel and useful”, based on the definition of creativity as:

“The ability to produce work that is both novel (i.e. original, unexpected) and appropriate (i.e. useful, adaptive to task constraints)” [89, p.5].

This definition of creativity came from the empirical assessment of creative performance stories from about 400 managers in organisations, and it is chosen as a working definition of creativity in this work as the most common sociocultural definition of creativity [162] in the literature that I encountered. It is similar to two other widely accepted definition of creativity: “Creativity is the process of generating unique products by transformation and combination of unique products. These products must be unique only to the creator, and must meet the criteria of purpose and value established by the creator” [94, p.107]; “Creativity is the generation of ideas, which are a combination of two or more matrices of thought, which are considered unusual or new to the mind in which the ideas arose and are appropriate to the characteristics of a desired solution defined during the problem definition and preparation stage of the creative process” [192, p.5].

Boden’s theory of creativity categorization [21] would recognize this as P-creativity (psychological, individualist definition of

creativity, ‘c creativity’ [96]), while if the entire community recognizes the product’s value and originality, it would be seen as H-creativity (historical creativity, ‘C creativity’ [96]). In this work we focus on the recognition from the suitable knowledgeable social group (i.e. domain experts, a situationally appropriate community subset), also known as “s-creativity” [183]. Therefore, the working definition of creativity in this research is expanded to the following:

The ability to produce work that is both novel (i.e. original, unexpected) and appropriate (i.e. useful, adaptive to task constraints), as recognized by a suitable knowledgeable social group (i.e. domain experts).

Czikszentmihalyi, one of the key contributors in the creativity research field, when challenged to describe a creative thinker, wrote: “there is not much to write about, since creativity is the property of complex system and none of its components alone can explain it” [176, p.33]. So what does this system look like? The investigation of delivery of creativity support is often linked to influencing 4 overlapping components of the well-established Rhodes’s “4Ps” model of creativity [89]: press, product, person and process (Figure 2-9). The components refine into definitions of the features of the creative climate, the properties of the creative results, the characteristics of creative people, and the stages within the creative process.

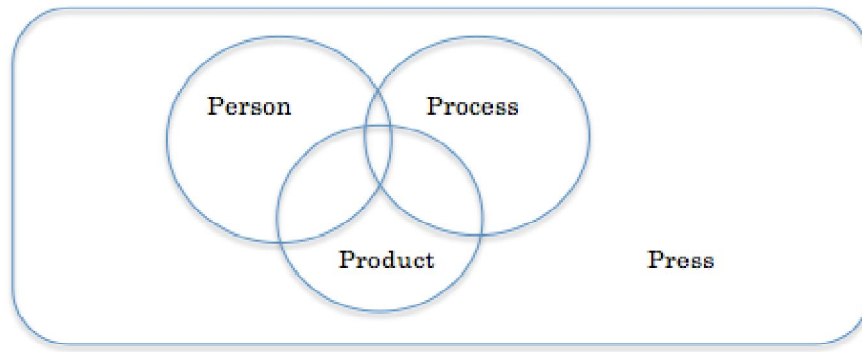


Figure 2-9: Rhodes's "4Ps" model of creativity [89].

In the next subsections, I discuss each of the components in more detail, and outline the opportunities for interventions relevant to this project.

2.2.1.1 *Press*

Press stands for "the climate, context, culture, environment, situation or place where creativity takes place" [89, p.16]; "external forces or pressures acting on the creative person or process, such as social and cultural context" [162, p.11]; "the conditions related to participants involved in the creative process and situations related to developing the final output" [187, p.101]. There has been extensive research into the factors that contribute to, or jeopardize the creative climate, and I relied on those findings when constructing the literature mapping that served as a foundation for the CGBL framework. The established creative climate factors are: *Challenge/Involvement*; *Trust/Openness*; *Idea-Time*; *Playfulness/Humour*; *Conflict*; *Idea-Support*; *Debate*; *Risk-taking*. This set is a result of a series of studies conducted in

a number of organisations in the period 1983-2007 by Isaksen, Ekvall, and others [54, 88].

In the context of serious games, Press could be seen as the application domain in which the contribution of the game in the form of social change or motivated learning is made. It is also important to have a deeper understanding of the concrete conditions where the session is taking place, by taking into account the creative climate of the particular instances of space, organisational culture, and environment [88].

2.2.1.2 *Product*

Research on creative products focuses on “the products judged to be novel and appropriate by the relevant social group” [162, p.11] and is almost always defined and evaluated using the sociocultural definition of creativity stated previously in this section (see Section 2.2.1). Furthermore, there is an agreement in theory that creativity is neither completely domain-specific nor domain-general, and is in fact a result of the combination of the two [96]. Also, one can rely on verified methods to measure [146] and develop [176] creativity, at least to some degree [129, 162].

A creative outcomes assessment, both immediate and longer-term, was applied as one of the measures of success of interventions made in my summative evaluation, reported in Chapter 6. One of the most established methods for assessing a creative product is Besemer’s Creative Product Semantic Scale [89] questionnaire, and I used an adapted version of this method

in assessing creativity in this project. It is based on asking domain experts to rate the characteristics required in a product for it to be considered creative in the context based on the criteria of useful and effective novelty [40], as it has been determined by various studies that a product has to be assessed in relation to the context for which the product was created [193].

Besides the assessment of novelty and usefulness, there could be customised criteria related to domain-specific “stylistic elaboration and synthesis” requirements [89, p.16]. Often used additional measures are: fluency (i.e. the total number of relevant ideas); flexibility (i.e. the number of different approaches or categories of ideas produced); and elaboration (i.e. the number of later-added ideas) [89].

Therefore, in the serious games context, I see a product as an obtained experiential benefit beyond entertainment, such as social change, motivated learning or game user experience, that can be assessed.

2.2.1.3 *People*

Creative people are defined by individualist definitions of creativity (i.e. concerning personality traits or types), or indirectly, as those who have generated creative outcomes [162]. In this research, creativity is not seen as a quality of a few individuals that is fixed and cannot be enhanced. Instead, I support the social-democratic discourse on creativity [10] that argues for creativity as “inherent in the every day cultural and

symbolic practices of all human beings” [176, p.51] and an inclusive “educational policy tool for personal empowerment and ultimately for social regeneration” [176, p.51]. The effectiveness of application of creativity techniques in enhancing individual creativity has been extensively evidenced and has been tested in various everyday domains [89, 162, 177].

Some characteristics of creative people, which are changeable and situation-dependent, are the following: flexibility; originality; curiosity; fluency; risk-taking; tolerance of ambiguity; capacity to make order from chaos; independence; openness; elaboration; and imagination [89, p.9]. Creative thinking endeavors could be taken up individually, or as a social process. Many authors argue in favour of the potential of social creativity [162, 193], mainly because of the benefits of diverse input.

Recent research [75] showed that games have significant cognitive, motivational, emotional and social benefits for players, which I assume could implicitly and positively affect their creative abilities. However, one’s personal creative abilities and their assessment, although significantly present in the field, have not been a part of the scope of this research.

2.2.1.4 *Process*

There is also a large body of knowledge on the subject of creative process and its models, aiming to explain “the processes involved during creative work or creative thought” [162, p.11] (Figure 2-10). Creative process models are not always linear and vary in the

number of stages that lead to creative problem solution, and sometimes their differences can be difficult to define. Different application domains tend to deploy different models: in education Cropley's model is often adopted, in HCI Shneiderman's model is popular, while in design IDEO's model is often used [182] (Figure 2-10). In the abstract, they all firstly define the problem, develop the relevant insight, conceptualise the problem, then design and develop a solution, and test or implement the solution [182].

Because of its clarity and evidence-based effectiveness in teaching creativity skills, I have been using the Creative Problem Solving (CPS) model [89] to implement and facilitate a creative process in my serious game design. In particular, I relied on the following framework adaptation made by Sawyer [162, p.88-90] in 2012, as in my opinion it is the most complete outlook on the creative process in comparison with other models depicted in Figure 2-10, which defines its 8 stages as follows:

1. ***Find and formulate the problem.*** *The first step is to identify a problem and formulate the problem in such a way that it will be more likely to lead to a creative solution.*
2. ***Acquire knowledge relevant to the problem.*** *Creativity is based on mastery, practice, and expertise.*
3. ***Gather a broad range of potentially related information.*** *Creativity often results from alert awareness to unexpected and apparently unrelated information in the environment.*
4. ***Take time off for incubation.*** *Once you have required the relevant knowledge, and some amount of apparently unrelated information, the unconscious mind will process and associate that information in unpredictable and surprising ways.*

5. ***Generate a large variety of ideas.*** *Unconscious incubation supports the generation of potential solutions to the problem, but conscious attention to the problem can also result in potential solutions.*
6. ***Combine ideas in unexpected ways.*** *Many creative ideas result from a combination of existing mental concepts and ideas.*
7. ***Select the best ideas, applying relevant criteria.*** *The creative process typically results in a large number of potential solutions. Most of them will turn out not to be effective solutions; successful creators must be good at selecting which ideas to pursue further.*
8. ***Externalise the idea using materials and representations.*** *Creativity is not just having an idea; creative ideas emerge, develop, and transform as they are expressed in the world.*

The creative process is not a singular cognitive process – it involves many processes in each of the stages. Game mechanics could explicitly support some of these stages, as well as creative processes that can support the aim of the game (see Chapter 5). This presents a relevant research challenge, as suggested by Sawyer: *“The creative process in contemporary multimedia art forms has just barely been studied: digitally animated movies; computer games; advertising and graphic design”* [162, p.430], from a designer’s and participant’s perspective alike.

Sawyer (2012)	Wallas (1926)	CPS (2000)	IDEAL (1984)	Sternberg (2006)	Possibility thinking (2006)	UK QCA (2005)	Synectics (1961)	Mumford (2004)	IDEO (2001)	Cropley (2001)	Schneiderman (2001)
Find and formulate the problem		Framing problems	Define goals	Redefine problems	Posing questions	Questioning and challenging		Problem finding			
Acquire knowledge relevant to the problem	Preparation	Exploring data	Learn	Know the domain			Groundwork	Information gathering		Preparation	Collect
Gather a broad range of potentially related information			Look		Immersion	Envisioning what might be	Immersion		Observation	Information	
Take time off for incubation	Incubation	Constructing opportunities	Explore possible strategies	Take time off	Play	Keeping options open		Concept search		Incubation	Relate
Generate a large variety of ideas	Insight	Generating ideas		Generate ideas	Being imaginative	Exploring ideas	Divergent exploration	Idea generation	Brainstorming	Illumination	Create
Combine ideas in unexpected ways		Developing solutions		Cross-fertilize ideas		Making connections and seeing relationships		Conceptual combination			
Select the best ideas, applying relevant criteria	Verification			Judging ideas		Reflecting critically on ideas	Selection	Idea evaluation		Verification	
Externalise the idea using materials		Building acceptance	Act and anticipate outcomes	Sell the idea	Self-determination		Articulation of solution, transformation	Planning and action monitoring	Rapid prototyping, refining, implementation	Validation	Donate

Figure 2-10: Mapping of the creative process stages across the most influential models that I created by combining reviews from the sources [89, 162,

182].

2.2.2 Creative problem solving

There are many links between creativity and problem solving, as initially suggested by Guilford [77]; whilst *“problem solving often has creative aspects, but creativity is not always problem solving”* [89, p.22]; making creative problem solving a subset of problem solving activities that is *“characterised by novelty, unconventionality, persistence, and difficulty in problem formulation”* [89, p.22]. Guilford then also recognised and established the concepts of “divergent and convergent thinking”, where divergent thinking is defined as *“involving processes like shifting perspective, transforming or producing multiple answers from the available information and because of that is able to produce novelty”* [41, p.102]; convergent thinking is defined as *“involving processes like focusing on giving correct answers to given questions, recognizing what is familiar and preserving what is already known, and therefore, not producing novelty”* [41, p.103]. Whilst both produce outcomes, one delivers “production of convention” (i.e. usefulness), whilst the other delivers “production of variability” (i.e. novelty) [42] – when joined, the results are truly creative solutions to given problems, as in the definition of creativity I endorsed (see Section 2.2.1).

The opportunity that arises from combining the two approaches, present both in creative thinking and problem solving, is in enabling one to face a wide variety of challenges by applying a *“very diverse collection of strategies, tools and approaches”* [89, p.22]. The CPS framework developed by Isaksen et al. [89] (see Figure 2-10), which was adapted and applied in this work,

recognizes this dual nature of CPS, providing guidelines to facilitate the CPS process in a way that would allow both generating (i.e. creative thinking, divergent thinking) and focusing (i.e. problem solving, convergent thinking) in each of the main process components. The effectiveness of CPS has been firstly investigated and demonstrated to be effective through interdisciplinary analysis of arts and sciences practices by Rothenberg in 1970s [155]. Other CPS training frameworks with proved effectiveness include: Syntectics [72], CoRT [44], and TRIZ [5].

Another successful toolkit for creative problem solving process facilitation, which was conceptualized as a TRIZ adaptation, is in the form of a card game called PRIZM [141]. This toolkit was successfully applied in a 4-year creativity workshops project with an engineering industry partner, resulting in significant solution benefits of joining creative thinking and problem solving in a real-world setting [141].

2.2.3 Creative learning

Creative learning is one form of facilitated CPS, and as a method supports my “creating meaning” theoretical position on the state-of-the-art serious games for motivated learning, presented in Section 2.1.2, which is about encouraging players to take upon a more active, co-creational role in the game play. Creative learning is described in [71] as teaching for understanding rather than teaching for transmission, delivered by facilitating thoughtful discourse development rather than applying direct instruction,

what was called inquiry-based approach [188] – an idea as old as Socrates, yet there are potentially many unexplored ways to put it in practice.

A new field of science, called the “learning sciences”, emerged at the start of the 21st century to investigate creative learning practices [162]. Some initial results show that *“creative behaviour emerges from learning environments in which students build their own knowledge through exploratory talk and sustained argumentation”* [162, p.395]. Many contemporary scholars argue that creative learning should be embedded in all subject areas in schools [38, 64, 125], and that modern curricula in all subjects should aim to result in cognitive outcomes that support creative performance [162].

When facilitating development, the focus could be put on either the outcome or the process. If the focus is on the usefulness and originality of the outcome, the goal is innovation; when the focus is on the process, the goal is creativity, as training in possibility thinking [38]. There could be creativity without innovation, but there could not be innovation without creativity [89]. Therefore, the CGBL framework in this project is designed to primarily support creativity, rather than innovation per se, providing players with *“generic strategies to reconstruct existing knowledge in ways that allow them to accommodate in fairly rapid fashion new information and ideas”* [125, p.42]. In the literature on creative learning, this concept is also related to the terms of strategic knowledge [169] and metacognition [4].

Mayer [120, p. 203] defined creative learning as “when students use active learning strategies for mentally representing new material in ways that lead to problem solving transfer”; and defined creative learners as those who do well on both “retention problems” (i.e. presented during instruction) and “transfer problems” (i.e. not explicitly taught). The students who were taught learning strategies that encouraged them to identify relational statements and to extract generalizations from texts showed greater creativity skills on transfer problem solving assessment afterwards. Furthermore, Ericsson [56, p.43] claimed that people could be taught to think beyond retention problems by “*circumventing basic information processing limits by enhanced anticipation*”. Another author suggests this could be achieved by “*seeking to uncover meaningful patterns which suggest one kind of strategy over another*” [125, p.43]. Such pattern recognition in problem solving transfer in the process of creative learning has been shown to be prompted by reflection [114].

Reflection in the context of learning is defined as “*a generic term for those intellectual and affective activities in which individuals engage to explore their experiences in order to lead to new understandings and appreciation*” [24, p.3]; “*a dialogue of thinking and doing through which one becomes more skillful*” [164, p.31]. Reflective practice is recommended in almost all professional environments [22]. When reflecting, creativity skills are those that allow us to go beyond intuition towards expertise. As reported in [8, p.70]: “*...intuition operates at a tactical, moment by moment level and is mainly product of experience, whereas expertise is strategic in that it involves not only the opportunity to put our intuitions into practice but incorporates a ‘feedback’*”

mechanism whereby evaluation of how things worked out and consideration of how things can be improved upon are key elements". This could lead to new levels of motivation and communication within a team, because, as Kemmis states [99, p.141]: *"We are inclined to think of reflection as something quiet and personal. My argument is that reflection is action-oriented, social and political. Its 'product' is praxis (informed, committed action), the most eloquent and socially significant form of human action."* On the importance of reflective conversation in occupational creative learning, Schön [164, p.61] says that the role of reflection is to *"surface and criticize the tacit understandings that have grown up around the repetitive experiences of a specialized practice, and can make new sense of the situations of uncertainty or uniqueness which he may allow himself to experience."*

Facilitating this kind of group reflective conversation through combinations of creativity techniques to manipulate information exposed, and game mechanics to drive interest in an interactive experience, can provide new opportunities to create meaning (see Section 2.1.2). As a result, professional creative learning benefits could be gained in a playful, flexible and safe training environment, which aims to overcome the traditional limitations of the classroom (i.e. *"real inquiry almost never happens in the classroom"* [162, p.401]).

Therefore, the purpose of introducing creative learning into classrooms and trainings is not only to facilitate the creative process during learning, but also, more importantly, to equip players with creativity skills to replicate the process in the future.

The game prototypes developed in this project were designed to support players' creative learning objectives through reflection and collaboration.

2.2.4 Creativity and play

Creative learning has also been shown to be supported by play. Sawyer [162, p.71] argues for the creative learning benefits of “*uniquely improvisational nature of social pretend play*” amongst young children, based on the aspects presented in Figure 2-11: contingency (i.e. turn-taking), intersubjectivity (i.e. role-playing and world-building), and emergence (i.e. collaborative creative process).

As a result of efforts to investigate further the relation between creativity and the unstructured play in childhood, several longitudinal studies revealed a correlation between adult creative abilities and the quality of pretend play in one's childhood [158]; yet the causal influence remains unclear. Play interventions can be designed to teach young children to play in more developmentally challenging ways [162], some of which explicitly aimed to enhance creativity [63] and resulted in success, which clearly has opened up an opportunity for more research. Whilst all these studies had young children as participants and domain-general objectives, there is not much research done on play interventions with intended CPS support in adult, occupational, domain-specific settings. That is taken as both one the challenges and a contribution in this research.

<i>Contingency</i>	During the play dialogue, each child's turn depends on the previous child's turn, and yet there's a broad range of possible creative acts: appropriate (the act has to make sense within the existing shared play world) and new (the act has to move the play drama forward).
<i>Intersubjectivity</i>	Children work together to create a shared, jointly created play world, with pretend roles, personalities, and plot events. This collective action is quite similar to what goes on in creative adult collaborative groups.
<i>Emergence</i>	The shared play world emerges incrementally, as each child contributes a small change to the plot, character, or scene by building on what has come before. Again, this process is similar to effective adult creative groups.

Figure 2-11: The improvisational aspects of play [162].

2.2.5 Conclusion

This section served to position the CGBL framework in the field of creativity research (Figure 2-12) and form an argument for its conception, by focusing on the relevant knowledge gaps. This section presented the definitions of creativity and background of the field that influenced my work (Section 2.2.1). My interest is then narrowed down towards problem solving applications of creativity (i.e. CPS), as described in Section 2.2.2, and a subset of those techniques that can be applied in learning (i.e. creative learning), as discussed in Section 2.2.3. Creative learning can be facilitated through play (i.e. creativity and play, play interventions), as explained in Section 2.2.4. Finally, the CGBL framework targets a specific variable setting of that research interest (i.e. adults as user group, occupational benefits as learning goals, domain-specific context).

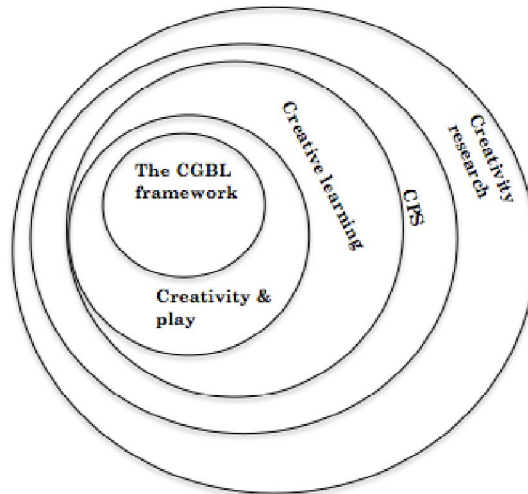


Figure 2-12: The positioning of the CGBL framework in the creativity research field.

2.3 Person-centred dementia care

In this section, the person-centred dementia care literature is reviewed in the context of it being the praxis domain in which this project intervened with the application of the CGBL framework.

2.3.1 Definitions

The term *dementia* describes the mental deterioration caused by the death of brain tissues that can have various physical causes, such as stroke or Parkinson's disease [47, 196]. The most common cause of dementia is Alzheimer's disease, a specific type of brain damage that currently has no cure and affects mostly the elderly. In the UK, Alzheimer's disease affects about 4% of all retired people and a fifth of over-85s – about 700 000 people, according to a report from 2010 [47], a figure expected to double by 2050 [196].

Dementia care is often delivered in residential homes, and in the UK, two-thirds of all home residents have some form of dementia [196]. Depression affects 20–30% of people who have dementia, and about 20% have anxiety [144]. The symptoms include: memory loss, short attention span, impaired judgment and logical thinking, challenging behavior and incapacity to perform everyday activities [175].

The person-centred care approach is at the core of good practice in dementia care [33], and focuses on the person, rather than on the symptoms, with respect to one's individual needs and characteristics [26, 196]. The person-centred approach to care has been acknowledged and promoted by the NHS [137], and its success relies heavily on the development of relationships and communication between all stakeholders (i.e. patient, family, friends, health service providers, local council) [27].

One literature review on person-centred dementia care research from 2013 [30] revealed the following intervention concepts:

- Environmental enhancement (e.g., plants and animals);
- Opportunities for social stimulation and fulfilling relationships (visits by children and increased interaction with other residents and staff);
- Continuity of resident care by assigning residents to the same care staff;
- Changes in management and leadership approaches (often devolved), with the introduction of democratized approaches to decision-making that involve residents and staff;

- Changes to staffing models focused on staff empowerment;
- Individualized (rather than institutionalized) humanistic philosophy of care.

These interventions have resulted in staff satisfaction and several psychological benefits to patients [30], and it is implied that the person-centred approach to care benefits not only the residents, but staff as well.

Sustained well-being of dementia sufferers and all other stakeholders included in the management of the dementia (i.e. carers, family members) is an important modern-day challenge, as the world population is becoming increasingly older and with modernisation their needs evolve [114], creating new pressures and challenges for the health and social care professionals.

2.3.2 Creative serious games for person-centred dementia care training

Related work in the field of games for health reports numerous serious games applications that target the health care professionals user group: exercises to refine skills needed for performing surgery [9]; emergency response and disaster preparedness [25]; making theoretical medical knowledge more accessible in junior doctor training through home-based programs [173]; simulations for health care management situations [100]; and assistance in communication with cancer patients [111].

Yet, there are hardly any examples of games that focus on the promotion of good practice in health and social care in disciplines that require highly customized solutions [136]. The notion of a customisable game intervention that promotes good practice methodology rather than delivering rapidly-aging facts is one of the main attempted contributions behind the CGBL framework developed in this project. So why is person-centred dementia care an especially appropriate application domain for the instantiation of the CGBL framework (see Chapter 4)?

A recently published literature review of dementia-related serious games [122] showed that there are numerous games supporting the cognitive and physical functions for the players with early-stage dementia, while the social/emotional function, which would encourage the players to connect with their community, is less present. With my game prototypes, I have been approaching this knowledge gap by targeting another user group in the community via a serious game with social/emotional function – care staff.

There are estimated to be over 6 million carers in the UK, according to a report from 2012 [131], who have been either employed in a care home or provide day-to-day support for a friend or relative. Care staff working in care homes are often poorly educated and inadequately paid [128], and the importance of the care staff support in provision of sensitive care is often neglected [83]. Investing in their education beyond medical and functional requirements towards improved communication and creativity skills has the potential to benefit not only dementia patients who directly depend on care staff's service, but also a

wider set of other stakeholders – family members and care home management.

The links between care staff training and quality of life, as well as with increased staff retention and job satisfaction, have been confirmed and analysed in research [1, 58]. Moreover, the benefits of an interdisciplinary approach to person-centred practice have been researched [83], but rarely practiced [1]. Competition in the private care sector is fierce [58]; therefore investing into care staff training and change management that would support creative learning and CPS in the work place could be beneficial for businesses. By training, staff need to be encouraged to feel appreciated for their contribution to the community, be given space for reflection and help for managing challenging situations, because they often lack time and support for doing so [128, 133].

A study was conducted into the relationship between stress, level of experience and person-centred approach to care [83]. Results showed that “stress was more often reported by care providers who had been working for 1 to 2 years (compared with longer); in addition, those who had been working for 1 to 2 years were more likely to espouse hopeful or person-centered attitudes than those who had been working for a longer period of time”; and also, “a person-centered attitude related to satisfaction, and perceived competence in providing dementia care was consistently associated with dementia-sensitive attitudes and job satisfaction” [83, p.1]. Dementia care is very specialized, and according to [47], more dementia-specific training resources should be made available to all staff to improve training effectiveness and reduce turnover. However, there are obstacles. A literature review by

Beeber et al. (2010) [18, p.1] reports that “staff training is challenged by low staff attendance, lack of organizational support, and financial limitations”. Another literature review, by Kuske et al. (2007) [106, p.1] evaluated 21 studies of dementia care training delivery in residential care homes, mostly in the US. The results revealed a “need for well-defined and methodologically improved studies, providing conclusive evidence of the effects of intervention types”, because “owing to methodological weaknesses and a lack of follow-up evaluations, little or no evidence existed for the efficacy” of the observed trainings. One later study [85] did show by using a randomized trial, that staff training can positively influence staff confidence in dealing with behaviour associated with dementia, recognizing that it is one of many factors influencing performance as a paid carer.

One example of a serious game training for the dementia care sector is an immersive 3D Virtual Care Home game for PC [142]. This environment supported reflection about typical forms of challenging behaviour exhibited by residents. A trainee carer could experience, resolve and reflect on different challenging situations in a virtual and hence safe environment. Trainee carers received tutorial guidance from a virtual learning companion. The evaluations of the environment in pilot residential homes have been positive, revealing that carers are able to navigate, interact with and engage with it. However, the support for creative thinking in this game was limited by: i) the contents that do not support creative input by the players or facilitation of the creative process by the game; ii) strict game boundaries that do not support bending of the game rules; iii) interface and technology

that do not support direct real-time collaboration, creative expression or reflection between the players.

That said, the environment provided no explicit support for creative thinking in order to generate novel plans to manage challenging behavior and only limited support for implicit creative problem solving in the form of game simulations that carers can run. The need was recognized for creative learning interventions for care staff, which could support carers in devising imaginative and successful ways of dealing with challenging situations with a flexible mind [114], which the application of the CGBL framework reported in this thesis seeks to address. Subsequently, I attempted to deliver a serious game with social/emotional function that provides care staff as an often-neglected user group with creativity skills, which they could use in their meetings to plan and deliver person-centred care. The creative practice is shown to have a wider impact on well-being [125], and could implicitly improve professional performance among this diverse user group.

2.3.2.1 *Instructional content*

One who cares for a person with impaired memory is often faced with situations classified as challenging. The key to resolutions in these situations is to reveal its causes with empathy [179]. *My Home Life* themes [132] define best practice in care home based on research evidence that would help all the stakeholders deal with the challenges in an emphatic way. These themes were created based on the *My Home Life* authors' literature review, and

provide guidelines for the residential care, cover a range of issues, such as from managing transitions when moving to a care home, end-of-life support, and promoting positive culture in care homes.

In my design, I was supporting a subset of themes focusing on “Personalising and individualising care”: *Maintaining identity* (i.e. getting to know the resident), *Creating communities* (i.e. connecting the resident), and *Sharing decision-making* (i.e. involving the resident) (Table 2-2). I focused on these themes to support staff in person-centred approach to care (see Section 2.3.1), which could particularly benefit from creative thinking training (see Section 2.3.2).

Maintaining identity	• Person-centred care • Supporting resident’s choice and control • Offering space for intimacy and privacy • Staff assignment • Biographical work • Communication skills • Sustaining friendships and link to the community • Recognising ethnic, cultural and spiritual needs • Participating in meaningful activities • Staff support
Creating communities	• Relationship-centred care • Positive relationships between staff and residents • Supporting reciprocity between staff and residents • Companionship and support between the residents • Active engagement of family and friends • Bringing in the wider community • Community activities • Working with animals and children • Physical environment • Leadership and teamworking
Sharing decision-making	• Residents and relatives as expert partners • Taking positive risks • Staff training • Time and commitment • A resident’s prerogative

Table 2-2: *My Home Life* guidelines for delivering “Personalising and individualising care” [132].

2.3.3 Conclusion

This review has shown that person-centred dementia care is a dynamic and uniquely demanding domain that can benefit from both novel and useful solutions to its challenges [199]. Care staff as a user group are a direct link to the generation and implementation of such solutions. This section provided an overview of domain-specific related works that influenced my research, the arguments for the need of creativity support and game-based learning in dementia care staff training, and the context for implementing the CGBL framework in this domain. Through this work, my aim was to contribute to the practice of person-centred care and staff development working in residential care.

2.4 The chapter summary

This chapter provides the reader with a literature review that sheds more light on the problem statement defined in Section 1.6 in terms of three main areas of contribution: serious games, creative problem solving and person-centred dementia care; and serves as an introduction to my theoretical contribution that is described in Chapters 3 and 5.

In Section 2.1, the reader was provided with definitions of serious games and relevant background research, as well as with my observations on how state-of-the-art serious games come closer to creating meaningful player experiences beyond simulation. I analysed the possibilities in serious games design transformations

under three themes: contents, outputs and technology, and identified how the intended contribution of this research project, and in particular design and development of CSGs, is positioned in the context of these three themes.

Next, the potential of creativity support in serious games was discussed in Section 2.2, by looking at some of the basic concepts of creativity theory and what their role can be in designing a serious game for motivated learning, and in particular, how the CSGs are making a contribution as a special case of intervention in the field of creativity and play, which is in turn a special case of creative learning. Most creative learning employs practices of CPS, which is the field of creativity research I am contributing most with this thesis. The relations between all of these terms are explained in this section.

Finally, Section 2.3 provided a focused view on the problem context that this project investigates, and presented my position on the importance of researching person-centred dementia care as an application domain, and care staff as a user group that can benefit from creativity support in their work. It also specified the relevant instructional content implemented in my design and development work, described in Chapter 4.

Chapter 3 – The Creative Game-based Learning Framework

“If you want creative workers, give them enough time to play.”

- John Cleese, as quoted in *Best New Games* by Dale N. LeFevre,
2002

3.1 Introduction

With the motivation to support the integration of creativity support into games for motivated learning, the Creative Game-based Learning (CGBL) framework was derived from several existing theories of creativity and serious games. The framework describes and explains some of the key dimensions of the CGBL phenomena, outlining how to design its instances – creative serious games (CSGs) - and what effects they can generate. This chapter presents the outcomes of efforts to achieve *OBJ1* and to develop a first answer to *RQ1* (Figure 3-1) with a theoretical explanation and description of mechanics, dynamics, aesthetics and learning outcomes of a CSG.

Objective	Question	Outcome
OBJ1: Explore and theoretically describe the relationship between creativity and gameplay for motivated learning by proposing a domain-independent framework for creative game-based learning (CGBL)	RQ1: What are the shared and non-shared characteristics of creativity support and good game design?	Theoretical description of the relationship between creativity and SGs.

Figure 3-1: Theoretical contribution in bridging the gap between creative problem solving and serious games was the first objective of this research.

The theory is presented as a framework, because its level of abstraction goes beyond a model, which would be a representation, and towards what is an extendable explanation of the CGBL phenomena [31]. As the term itself implies, it gives a general frame from which instances are created, by instantiating the frame with more concrete solution instances that depend on the variables of a particular application domain. According to

Dix's classification of theories in HCI [31], this resulting theory is synthetic (i.e. both descriptive and explanatory), aggregate (i.e. non-universal, as it needs to be instantiated for a particular application domain when used, and relates to a specific targeted user group - adults in professional development setting; if it was universal it would work without such user group constraints), qualitative, and approximate (i.e. not deterministic).

This chapter presents the definitions and dependencies of its components. To this end, the chapter continues in two sections, presenting: i) the literature mapping created to determine the shared characteristics between creative climate (i.e. "context, culture, environment, situation or place where creativity takes place" [89, p.16]) and good serious games design principles (i.e. the dimensions of a good CSG user experience) in Section 3.2; ii) the CGBL framework, with its individual components description and grounding in Section 3.3. The literature mapping served to inform the framework with the key principles that a CSG should incorporate in its mechanics to achieve both its educational and creative purposes.

3.2 The dimensions of a good CSG user experience

Definition: The **dimensions of a good CSG user experience** are the characteristics required of a serious game to encourage creative thinking, and the user behavior that demonstrates creative thinking in game play.

Identifying the characteristics of climates common to both creative problem solving and good serious games design for motivated learning is an influencing factor for CSG design, because this task has not been approached by researchers. A literature mapping activity aimed to shed a light on differences in the two fields' perspectives, which when joined, could either be set as complementary strengths to amplify the learning experience and creative outcomes, as argued for in Chapters 1 & 2; or as contradictory, then intentionally eliminated in creative serious games design.

The starting point of the literature mapping was an established list of eight creative climate factors [89]: *Challenge/Involvement; Trust/Openness; Idea-Time; Playfulness/Humour; Conflict; Idea-Support; Risk-taking; Freedom*. This list is a result of a series of studies conducted in a number of organisations in the period 1983-2007 by Isaksen, Ekvall, and others [54, 88], and is often cited in the literature on creative climates.

The interpretation of creative climate factors by [88, 89] was contrasted with the interpretation of the terms in the serious games literature. I used the items from this set (i.e. SGs and eight factors), one by one, as the keywords in searching the online databases (Scopus, ERIC, Google Scholar) and the City University London library catalogue for reports on serious games, by refining the search with the keywords *Games* and *Learning* (e.g. "challenge + games + learning"). The search was performed in November 2011, and therefore included the reports published by that time. I relied on my ability to analyse and recognise synonyms and similarities between concepts in the material that

came out in the top search results, and select relevant influential quotes from those papers. The literature mapping method's primary purpose was exploratory (i.e. to uncover the main emerging themes and create links with CPS from a growing pool of interdisciplinary reports on serious games), rather than descriptive (i.e. to analyse and give structure to the complete set of the available knowledge).

The resulting considerations of the eight creative climate factors in the light of serious games literature were used to propose the dimensions of a good CGBL user experience, which can be used by CSG designers as design goals. These shared dimensions are summarized in turn in the following subsections.

3.2.1 Challenge

In a creative climate, the overcoming of challenges can guide people to find joy and meaning in tasks, as well as inspire them to initiate more motivated involvement with their work [89]. This dimension signifies one's involvement in a task. Likewise, in game play, a challenge is met when a learner gets a chance to operate within, but at the outer edge of resources, so that things are felt as challenging but not unmanageable [69]. A challenge that unfolds logically is a significant engagement factor [123] (e.g. overcoming of some posed obstacles, such as puzzles or quests where one solution opens up the game narrative into a next puzzle or quest, often results in players' feeling of achievement).

According to [66], in order to implement the right level of Challenge in games for motivated learning, goals should be clearly specified and meaningful to players, yet the possibility of obtaining the goal should be uncertain, and a small amount of informational ambiguity should be maintained throughout game play, similar to an experience of dealing with uncertainty of risk-taking. This can be achieved if a game designer manages to match the player's skills, vary the level of difficulty, balance an appropriate pace [184] and pose tasks that need effort and are non-trivial [195]. In this way the player is kept in a state between boredom and anxiety [149] in the zone of flow, therefore potentially facilitating creativity [43].

3.2.2 Freedom

In a creative climate, allowing and rewarding active learner control can directly influence the level of acquisition and sharing of information about the task, and subsequently new modes of action can emerge from the interaction [89]. The concept of freedom in game play is closely related to the personalization of navigating obstacles, and it is recognized as an influential contributor to users' engagement [123]. If freedom is supported during play, players feel they have something individual to them that they can customise [32]. Overall, the sense of control over actions [184] is empowering.

Freedom is enhanced when users are allowed to select strategies, manage the direction of activity, and make decisions that directly affect outcomes, even if actions are not instructionally relevant

[66] (e.g. pick a character they are going play in the game, select areas to explore etc.). In Section 1.2.1, I discussed the importance of making decisions and enabling design and development of artefacts within games [152], making the instructional content and rule sets flexible and dynamic enough to accommodate creative thinking. Moreover, controls of the game and its contents were identified as key barriers to immersion and engagement [20, 29], supporting an argument for accommodating more freedom in a game as a boost to its user experience.

3.2.3 Trust and safety

In a creative climate, the definition of trust is connected with openness and emotional safety in relationships – it is assumed that people have respect for one another and give credit where it is due [89]. Similarly, one reason that serious game play is recognized as an effective learning tool is because it provides a space in which to explore hypotheses and to fail safely [123]. Any consequences remain safely within the training setting [20], thereby encouraging greater risk-taking and questioning of ideas in a positive context, thereby increasing their intrinsic motivation [66].

For example, to foster trust and safety, games can explore opportunities for social interaction, such as cooperation, social interaction between the players (chat, etc.) and social communities inside and outside the game [184]. Such engaged teamwork may lead to more motivated learning and better

practice outside the training setting, thereby improving the CSG user experience.

3.2.4 Humour and playfulness

This characteristic of a creative climate manifests itself through the spontaneity and ease of the people in it and the effect on their social, emotional and cognitive behavior in the climate [89]. Humour has been used in game play for contextualising game mechanics, fostering communication, learning and socializing within a game, making it a better experience for players [51] (e.g. appropriately funny graphics can have benefits from prompting conversations to general amusement of players). The connection between playfulness and creativity has been also elaborated in Section 2.2.4, arguing for the creative learning benefits of improvisational aspects of social pretend play [162] whose aspects of contingency, intersubjectivity and emergence positively influence creative thinking in children and young adults. Whilst playfulness was previously researched in the context of game-based learning [153] and creativity [102], the role of humour rarely features in the serious games literature, and it has the potential to be investigated further [51], especially in the context of CSGs as a specific subset of SGs.

3.2.5 Idea-support

In a positive creative climate, new ideas are treated attentively and professionally [89] by all stakeholders. A similar level of support for ideas is sometimes needed in serious games, because

ideas need to be preserved for the assessment of learning outcomes and to respond to the learner's actions and progress within a game [20]. One way to support ideas is to present performance feedback in a way that takes into consideration possible damages to one's self-esteem [117].

This feedback on ideas from other participants or the game itself, if positive, could be seen as a form of reward, making the player aware about his or her good progress through the stages of problem solving [149]. These rewards could be customised from the beginning to each learner's level, effort, and growing mastery, actively supporting the players in creative learning. Through giving the opportunity to practice CPS, the game design can support the transfer of knowledge acquired in a creative serious game to the future real-world situations [69] in a considerate, open and clear manner that enables relevant idea exchange [163] and team building through creative learning.

3.2.6 Conflict

The need to foster conflict and competition between players or between the player and the game is an often-reported game characteristic, as a mechanism to increase one's performance [20] while facing challenges and problem solving [149]. Conflict in serious games is defined by [80] as a set of tensions and design dilemmas that the game generates for participants in the form of trade-offs and competitions (e.g. balancing of game resources, in a way that causes penalties for another player). However, even though contemplating trade-offs can sometimes be a trigger to

idea-generation [129], conflict and competition are sometimes undesirable characteristics of a creative climate that can lead to interpersonal warfare [89]. This was further confirmed by a study [20, p.38] that concluded that “for the groups [of students] that were doing really well, competition was highly motivating, but for those that weren’t, it was demotivating”, potentially jeopardizing group dynamics and participants’ self-esteem. In conclusion, conflict is a shared dimension, but sometimes the effects of conflict are not compatibly shared between creative climate and good game design, and therefore, as a dimension, it is not desirable in a CSG design.

3.2.7 Idea-time

In a supportive creative climate, there should be sufficient time available to people to generate and elaborate ideas over multiple sessions, i.e. their ideas need to persist in the problem solving space within a flexible timeline [89], while keeping in mind that persistence does not guarantee a solution. This also means that one does not play against the clock, but rather takes time to solve the problem at hand, which is contrary to engagement mechanics of timers (i.e. counting down the allowed game time) in games [123]. However, the characteristic of persistence has a role in serious game play because it can help to preserve players’ personalisation of the game world [32], which is also recognized as a ‘freezing effect’ [16]. Yet, there is a danger that persistence can negatively affect the flow which participants experience, by slowing down the creative process and keeping players from

moving forward towards a solution. In creativity workshops, it is often a facilitator's role to make sure this does not happen.

3.2.8 Risk-taking

The dimension of risk-taking, in creative climate is understood as tolerance of ambiguity and uncertainty [89]. In the serious games literature, risk-taking is interpreted very similarly to other already discussed dimensions – *Challenge*, *Trust & safety* and *Freedom*, as it is related to personalised navigation of obstacles, and negotiation when making decisions and safety of taking action. Therefore, this concept was merged with those preceding considerations, with its further distinguishing in the framework becoming redundant for most application domains. The described merging made the risk-taking not a relevant priority, and not a shared characteristic between the fields of creative problem solving and SGs.

3.2.9 Conclusion

The analysis revealed some game features to be excluded from CSGs design (i.e. Conflict-related) and more opportunities to introduce some features into serious games through explicit creativity support. The results were narrowed to six CGBL dimensions, shared between the fields of CPS and SGs, that facilitate both a positive creative climate and an engaging serious game design: Challenge, Freedom, Idea-support, Idea-time, Trust & safety, Humour & playfulness.

This literature mapping had an important role in the analysis that led to the conception of the CGBL framework, identifying both the characteristics required of a serious game to encourage creative thinking, and the user behavior needed to demonstrate creative thinking in game play. The CGBL framework supports the implementation of these dimensions in CSG design. I assume that, although it is desirable, not all of the dimensions have to be strongly experienced in a single CSG in order to implicate overall good CSG user experience. Evaluating the success of the implementation of these dimensions is therefore one metric for a good CSG user experience, which designers can utilise and researchers can refine, expand or dispute through future empirical studies. However, it was not investigated further in this doctoral research.

3.3 The CGBL framework

The CGBL framework is an instantiation of the MDA framework (see Chapter 2, Section 2.1.1.5) that applies systems-thinking to describe the interplay of the elements of a game, and how that interplay is experienced from the perspectives of both a game designer and a game player.

Definition: **The CGBL framework** is constructed to describe interactions between game mechanics, dynamics and aesthetics (Figure 3-2) in a special type of games – serious games for motivated learning with integrated creativity support, that I called **creative serious games**

(CSGs). CSGs aim to involve players in creative learning through gamified CPS.

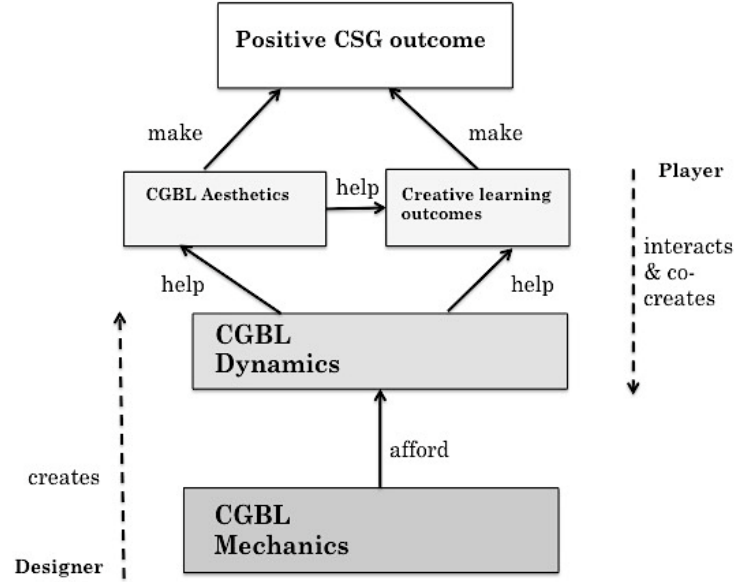


Figure 3-2: The CGBL framework overview, which illustrates the main components of a CSG, their dependencies and involved actors. The CGBL Mechanics created by a CSG Designer afford the CGBL Dynamics to play out and are co-created by CSG Player. That process helps the CGBL Aesthetics and creative learning outcomes to emerge, together making a positive CSG outcome.

Definition: A **Player** is a stakeholder who interacts with a CSG and co-creates its contents during participation in the *CGBL Dynamics*. The participation of *Player* then results in achieving a *Positive CSG outcome*, which consists of experiencing *CGBL Aesthetics*, and achieving *creative learning outcomes*.

Definition: A **Designer** is a stakeholder who creates and implements the *CGBL Mechanics* that afford the *CGBL*

Dynamics, having as main goals but not having a direct creative impact on: i) good CSG user experience (i.e. Player's experience); ii) *Player* achieving *Positive CSG outcome*.

As stated at the beginning of this chapter, the theory presented here is a framework because its components (i.e. its *mechanics*, *dynamics*, *aesthetics*, *creative learning outcomes*) are more of a “black box”, extendable in design depending on the input of variables of a specific instance and its application domain [31]. The framework aims to propose answers for not only the hows, but also the whys about the CGBL phenomena, especially about the *dynamics-aesthetics* and *dynamics-creative learning outcomes* dependencies, from the perspectives of the *Player* (i.e. user) and *Designer* actors. Therefore, the framework is envisioned to be of use to both game designers and researchers, when working towards understanding with an interest in methods for achieving *Player's* and *Designer's* goals in a CSG.

Allowing the creation of artefacts within the game and expansion of the game rules beyond implemented boundaries would provide new context for interplayer and game-player interaction. Therefore, in this thesis, I argue for establishing a new type of player, in addition to Bartle's player types [12] (see Section 2.1.1.2) – named *Creators*, by proposing the CGBL framework that would explicitly support the design of games to accommodate and encourage creative behaviour in a game, and creative learning outcomes.

3.3.1 Positive CSG outcome

Definition: The goal of a **positive CSG outcome** is achieved if a Player experienced at least one creative learning outcome and one *CGBL Aesthetics* during the *CGBL Dynamics* process. This is the main goal for the Player that provides motivation to engage in a CSG.

A positive CSG outcome is a goal shared amongst *Player* stakeholders taking part in a CSG. According to Garris's IPO theory (see Chapter 2, Section 2.1.1.4), I had to consider why would one want to play a CSG, i.e. what makes the players engaged. My assumption was that the extended player interaction with the CSG can result in three particular forms of scaffolding motivation (i.e. motivation that is recursively boosted in a game cycle loop, as discussed in Section 2.1.1.4) during the game play: i) *curiosity* – intrinsic motivation to explore, create and learn about the game world; ii) *ownership* - controlling the use of game components increases the player's status and creates engagement; iii) *affiliation* – playing as a team creates a feeling of belonging while working towards a shared goal [2, 78] (see Chapter 2, Section 2.1.1.6). Ownership and affiliation are especially characteristic of the CSGs, as they are associated directly with the act of creative learning through gamified CPS, and are not as common in other forms of the SGs. My assumption is that these motivation aspects positively influence the good CSG experience amongst players, as defined in Section 3.2; and I chose them accordingly. Table 2-1 illustrates with some examples the relationship between these motivation aspects and good CSG experience dimensions that I assumed.

Motivation	CGBL dimension	Explanation
Affiliation	<i>Trust and safety</i>	Working towards a shared goal and group reflection strengthens the trust within the group during and after the creative process.
Ownership	<i>Challenge</i>	An opportunity to influence the game by creating artefacts and making decisions influences the levels of challenge.
	<i>Freedom</i>	An opportunity to generate, document, discover and learn in a team is an expression of personalisation within the creative process, giving players some control over the process.
Curiosity	<i>Challenge</i>	Opportunities to explore, create, learn and discover within the CSG influences positively the levels of challenge.
	<i>Humour and playfulness</i>	Curiosity creates space for the play's aspects of emergence and intersubjectivity, smoothing and supporting the creative process.

Table 2-1: Some examples of the dependencies between the dimensions of a good CSG and targeted motivation aspects.

The CSG ends when a positive CSG outcome is obtained – players create their own ending for the game narrative (i.e. a generated final idea) that affords ownership, and obtain creative skills and domain-specialist knowledge and motivation through the process that afford affiliation and curiosity within the application domain context, whilst experiencing targeted aesthetics that benefit the creative learning outcomes.

3.3.2 Creative learning outcomes

Definition: There are 3 types of **creative learning outcomes** of the *CGBL Dynamics*: *gaining creativity skills*, *generating creative outcomes*, and *domain-specialist motivational and learning benefits* (all defined in Figure 3-3).

Achieving one creative learning outcome does not exclude the achievement of another. Each of these creative learning outcomes can be immediate or long-term.

Gaining creativity skills is a long-term, transferable creative learning outcome that turns players into creative learners (see Chapter 2, Section 2.2.3) who can tackle both ‘retention problems’ (i.e. presented during instruction) and ‘transfer problems’ (i.e. not explicitly taught) [120] of the application domain. By actively taking part in all stages of a facilitated playful creative process, it is assumed by [4] that the players will be able to re-use the showcased strategies in diverse real-world situations that require creative thinking and ‘metacognition’ (i.e. “generic strategies to reconstruct existing knowledge in ways that allow them to accommodate in fairly rapid fashion new information and ideas” [125, p.42]) (see Section 2.2.3). Effects are measurable only a certain period of time after a CSG session game play, and may require more than one exposure session. Longitudinal in-depth testing of this framework component was beyond the resources of this doctoral project. However, a follow-up questionnaire is a good method to at least partially assess the level of this CLO achievement, and I have applied it in my summative evaluation (see Chapter 6).

On the other hand, *generated creative outcomes* are immediately available after a CSG session, in the form of artefacts or ideas created by players through interacting with a CSG. The quality of a creative outcome can be externally evaluated for its novelty and usefulness in the application domain context [41]. I have also applied this method in my summative evaluation (see Chapter 6).

Acquiring domain-specialist learning and motivational benefits are creative learning outcomes that help put the generated creative outcomes and gained creativity skills into the application domain context, acquiring new specialist “understandings and appreciations” [24]. These outcomes can be both long-term and immediate, and are generated from reflections shared amongst players during the CGBL Dynamics (see Chapter 2, Sections 2.2.3 & 2.3.2), triggered by the interactions within a CSG. These CLOs can be evaluated using a combination of attitudinal metrics (i.e. what players self-report) and behavioural metrics (i.e. what players did) in qualitative data analysis collected from the playtesting, which is what I did in my studies (see Chapters 4 & 6).

Creative learning outcomes (CLOs)	
Gaining creativity skills	Long term CLOs in a form of “generic strategies to reconstructing knowledge in ways that allow them to accommodate in fairly rapid fashion new information and ideas [125, p.42]; ‘strategic knowledge’ [169], ‘metacognition’ [4] (see Section 2.2.3).
Generating creative outcomes	Immediate CLOs in a form of a product of a creative process that is relevant and useful [177] in the application domain context (see Section 2.2.1.2).
Acquiring domain-specialist learning and motivational benefits	Immediate and long-term CLOs in a form of shared reflections, when players “explore their experiences in order to lead to new understandings and appreciation” [24, p.3] in the application domain context (see Sections 2.2.3 & 2.3.2).

Figure 3-3: Defining creative learning outcomes.

3.3.3 The CGBL Aesthetics

Definition: The **CGBL Aesthetics** describe how the CSG should make the players feel during the game play

interaction. They are a composite outcome of the *CGBL Mechanics* and *CGBL Dynamics* during players' interaction with the CSG. There are four preferable types of basic dispositional outcomes: *joy*, *anticipation*, *surprise*, and *trust*.

In the MDA framework (see Chapter 2, Section 2.1.1.5), game aesthetics are defined as “the desirable emotional responses evoked in the player, when she interacts with the game system” [86, p.2]. In the CGBL framework, the desirable emotional responses are those that: i) help achieve creative learning outcomes, and ii) implicitly benefit good CSG user experience. Applying Plutchik’s theory of emotions [147] in the context of game aesthetics that support creative game-based learning, the following four basic positive emotions were recognized as eligible as the disposition outcomes of a CSG: joy, trust, anticipation and surprise. Other emotional responses (i.e. their negative emotions counterparts): fear, disgust, anger, sadness; should be avoided, in order to retain game play motivation levels [147].

Joy is a basic emotion triggered by an event of collection or a metaphorical win, which invites repetition, results in accumulation of resources [147], and feeds the game play motivational loop (see Section 2.2.1.4). Therefore, this emotion is desirable when generating artefacts or ideas, which are interpreted here as creative products made and managed by players during a CSG session. Hence, the joy experienced in co-creating is assumed to significantly help the goal of generating creative outcomes.

Anticipation is a basic emotion triggered by an event of exploration of a new territory, which invites examination, and results in mapping and knowledge-base building. This emotion can therefore be causally linked both with domain-specialist learning benefits and generating creative outcomes – putting players into a disposition that helps their explorative spirit to arise and elicit knowledge from each other.

Surprise is a basic emotion triggered by an unexpected event that invites one to stop and question the mystery input, take time to reorient, and react to changed circumstances. This is a disposition necessary for practicing flexibility and playfulness that are vital for the process of creative thinking in the moment (see Chapter 2, Section 2.2.4), and therefore also for generating creative outcomes and acquiring domain-specialist learning benefits.

Finally, *trust* is a basic emotion that is triggered by befriending and sharing with another, inviting caring behaviour and resulting in mutual support. Such a disposition is clearly very important in nurturing the empathy needed for creative thinking and sharing in a group, and gaining creativity skills through the process.

3.3.4 The CGBL Dynamics

Definition: The **CGBL Dynamics** are the players' interactions with the implemented *CGBL Mechanics* in the course of a creative process, which induces and supports the desired *CGBL Aesthetics* that the players experience and the *creative learning outcomes* that they pursue. The

execution of the CGBL Dynamics depends equally on designer-, player- and game-generated resources. Its main three stages are: *divergent thinking*, *incubation*, and *convergent thinking*; and there is its further activity refinement into eight phases.

In the MDA framework, game dynamics are defined as “the run-time behaviour of the mechanics acting on player inputs and each other’s inputs over time” [86, p.2]. In the CGBL framework, the CGBL Dynamics aim to extend Garriss’s IPO model of motivated serious game play behaviour (see Chapter 2, Section 2.1.1.4) with the support to creative learning through gamified CPS. At the core of the CGBL Dynamics is the creative process, implemented according to Sawyer’s adaptation of the CPS framework (see Chapter 2, Section 2.2.1.4) [162], which defines eight phases of the process:

- find and formulate the problem;
- acquire knowledge relevant to the problem;
- gather a broad range of potentially related information;
- take time off for incubation;
- generate a large variety of ideas;
- combine ideas in unexpected ways;
- select the best ideas, applying the relevant criteria;
- externalise the idea using materials and representations.

Phases i)-iii) mainly support *divergent thinking* stage, whilst phases v)-viii) mainly support *convergent thinking* stage. Different creative stages afford different dispositional outcomes and

creative learning outcomes. The creative process affordances towards the CGBL aesthetics are defined in Figure 3-4.

Creative process stages	The CGBL Aesthetics	Explanation
Divergent thinking	<i>Joy</i>	Tasks of formulating the problem statement, relevant knowledge acquisition, and wide-range information gathering – all have elements that suggest accumulation, which, if obtained, induce joyful disposition in an actor of events.
	<i>Anticipation</i>	Equally, these tasks require examination of an unknown problem domain and diverse input stimuli, and are often interrupted by unexpected events of discovery that shift perspectives, resulting in dispositions of anticipation and surprise.
	<i>Surprise</i>	
Incubation	<i>Anticipation</i>	During incubation, one is still actively exploring, but outside of the problem domain whilst received input settles in. Therefore, the examination and the potential for a twist in the story remain, allowing dispositions of anticipation and surprise to occur.
	<i>Surprise</i>	
Convergent thinking	<i>Trust</i>	Tasks of idea generation, combination, selection and externalisation facilitate the group work together towards a solution, potentially forging disposition of trust between actors. These tasks are often cooperative, and require sharing and mutual support when managing resources.

Figure 3-4: The affordance of the dominant disposition outcomes (i.e. the CGBL aesthetics) in the individual creative process stages.

All three main creative process stages contribute positively towards *gaining creativity skills*, as one needs to experience the process from beginning to end in order to be able to master the diverse CPS strategies [89] (see Chapter 2, Section 2.2.2). However, only the convergent thinking creative tasks (i.e. idea generation, combination, selection, and externalisation) are crucial for successfully achieving *domain-specialist learning and motivational benefits*, and *generating creative outcomes*. My assumption is that this is because these activities shape players'

problem solutions, while eliciting most collaboration and interaction amongst players, resulting in more sharing of domain-specialist knowledge and team support, as well as increasing the quality of the final creative outcome in terms of novelty and usefulness, through focusing, filtering and combining of input player-, game- and designer-generated resources.

A contribution of this research to Sawyer’s theory is to place his creative process model into a creative-learning-through-gamified-CPS context (the benefits of which have been discussed in Chapter 2), and give design recommendations for instantiating it accordingly.

3.3.5 The CGBL Mechanics

Definition: The **CGBL Mechanics** are the functioning components of a game that allow designer control over the levels of the game and the ability to guide player actions and behaviour by allowing control over game resources [200]. In the CGBL framework, this control and guidance is partially shared with the players through the course of the *CGBL Dynamics*, as players co-create some parts of the game contents – depending on their choices and ideas, different mechanics could be triggered. The CGBL Mechanics aim to directly support the *creative process*. There are 5 types of the CGBL mechanics: *resource management*, *variable challenge*, *collecting*, *customisation*, and *feedback*. I selected these mechanics on the basis of the literature review so that, when instantiated, they can help

the CSG designer to trigger and operate with the positive CSG outcome (both aesthetics and CLOs) in mind.

A designer of a CSG implements the mechanics that make the game's creative learning outcomes and aesthetics objectives. To this end, the CGBL Mechanics afford the principles identified by the dimensions of a good CSG user experience (see Section 3.2), required in a design in order to accommodate both a creative climate and good serious game experience with the CGBL Dynamics.

Resource management is a mechanism that allows players strategic control over resources generated by a CSG or the players themselves within a CSG, and it can be continuously activated throughout the creative process. To this end, *Collecting* is a mechanism that allows players to gain and generate resources that they can then manage, which is a particularly important task when populating the information set (see stages on gathering information in Sawyer's creative process model, Section 2.2.1.4) during the divergent thinking phases of the creative process. It involves players in activities related to saving, marking, tagging and displaying of resources. These two mechanics play an important role in supporting the good CSG experience dimension of Trust (see Section 3.2.3), as through the exchange and examination of resources, collaboration between players can be encouraged and strengthened. These activities strongly and implicitly encourage the aesthetics of *Joy*. The collaboration between players can also be put to a test, supporting the dimension of Challenge (see Section 3.2.1) with the playful aesthetics of *Anticipation* and *Surprise*.

Variable challenge is a mechanism that straightforwardly complements the dimension of Challenge. The challenges in a game vary to conform to players' abilities in a manner that allows them to stay in the state of flow, between boredom and anxiety. It also helps players to open up to new streams of thinking, and is therefore primarily applicable to the divergent thinking phases of the creative process, when players are exploring the possibilities of the expanding the information set.

Customisation is a mechanism that allows players to personalise the game resources and influence directly the CGBL dynamics through making decisions and artefact creation (see Section 1.2.1), which is an important tool for supporting creative thinking. This mechanism is therefore applicable in all phases of the creative process. By definition, it primarily supports the dimension of Freedom (see Section 3.2.2). Customisation also can allow players to take their time in navigating the game resources, hence supporting the dimension of Idea-time (see Section 3.2.7).

Finally, *Feedback* is a mechanism that facilitates the interaction between the players and their reactions to each other's input, fulfilling a need for meaningful social contact. By applying this mechanic in a CSG, a designer can hope to induce the Idea-support (see Section 3.2.5) and Trust (see Section 3.2.3) dimensions of good CSG experience amongst the players. Exchanges and support within a group create a feeling of trust when negotiating a choice or idea (i.e. problem solution) in the convergent thinking phases of the creative process, whilst the support for the expressed input opinions or reflections boosts

motivation. These effects mainly contribute to increase the aesthetic of *Trust*.

Humour and playfulness (see Section 3.2.4) is a CSG experience dimension reflected in all the CGBL mechanics by definition, as all the mechanics of a CSG serve to support emergent behaviours (i.e. behaviours that spontaneously occur during the game play) and playful interaction amongst players that are required for creative learning.

The CGBL mechanics

Resource management	Players must control, plan and deploy resources in order to achieve the game's goals.
Variable challenge	Adjusting challenges to match the ability of the players, to avoid them becoming bored or frustrated.
Collecting	An inherent human activity divided into saving, marking, tagging and displaying.
Customisation	Providing the ability to personalise aspects of a game world, enabling players to express their identity to others.
Feedback	Fulfils the need for meaningful social contact and helps players to improve performance.

Figure 3-5: Defining the CGBL mechanics.

The CGBL mechanics (Figure 3-5) are recommended for playing and creating in a group. Bringing professionals together to constructively play in a safe and fun environment has motivational [75] and creative learning benefits, and the potential to broaden a game's reach and cyclicity [200] (see Section 2.1.1.4). Diverse personal backgrounds of players in a group (e.g. level of professional experience), when adequately facilitated, may lead to more creative outcomes [89] in a CSG. More insight

regarding group collaboration and the influence of players' backgrounds was gained through attempts to instantiate the CGBL mechanics for a particular application domain (see Chapter 5).

Moreover, as reported in Section 2.1.1.2, most people have a socializer player type as their dominant player type in game play [200]. It is therefore important to carefully consider and integrate social interactions when instantiating the CGBL mechanics. The CGBL mechanics may often remain utilized throughout the whole CSG play (see Figure 3-6), contributing in and benefiting from both the divergent and convergent creative process phases, especially those mechanics that are Resource management- or Variable challenge-related.

Creative process stages	Mechanics	Explanation
Divergent thinking	Customisation	Choice of problem statement and game direction and features.
	Collecting	Collecting information through examinations of game- and designer- generated resources
	Variable challenge	Designer- and game-generated resource pose surprises for players
	Resource management	Players manage information gathered in the explorations
Incubation	Variable challenge	Examination continues, but in another, unrelated domain, shift of the activities
	Customisation	Choice of the activity in another domain
Convergent thinking	Resource management	Managing information gathered in the explorations
	Customisation	Generating, combining, selecting and externalizing ideas affords a personal mark on the game play
	Feedback	Mutual support between the players whilst collaborating on a solution as a team

Figure 3-6: The CGBL Mechanics support each of the creative process stages.

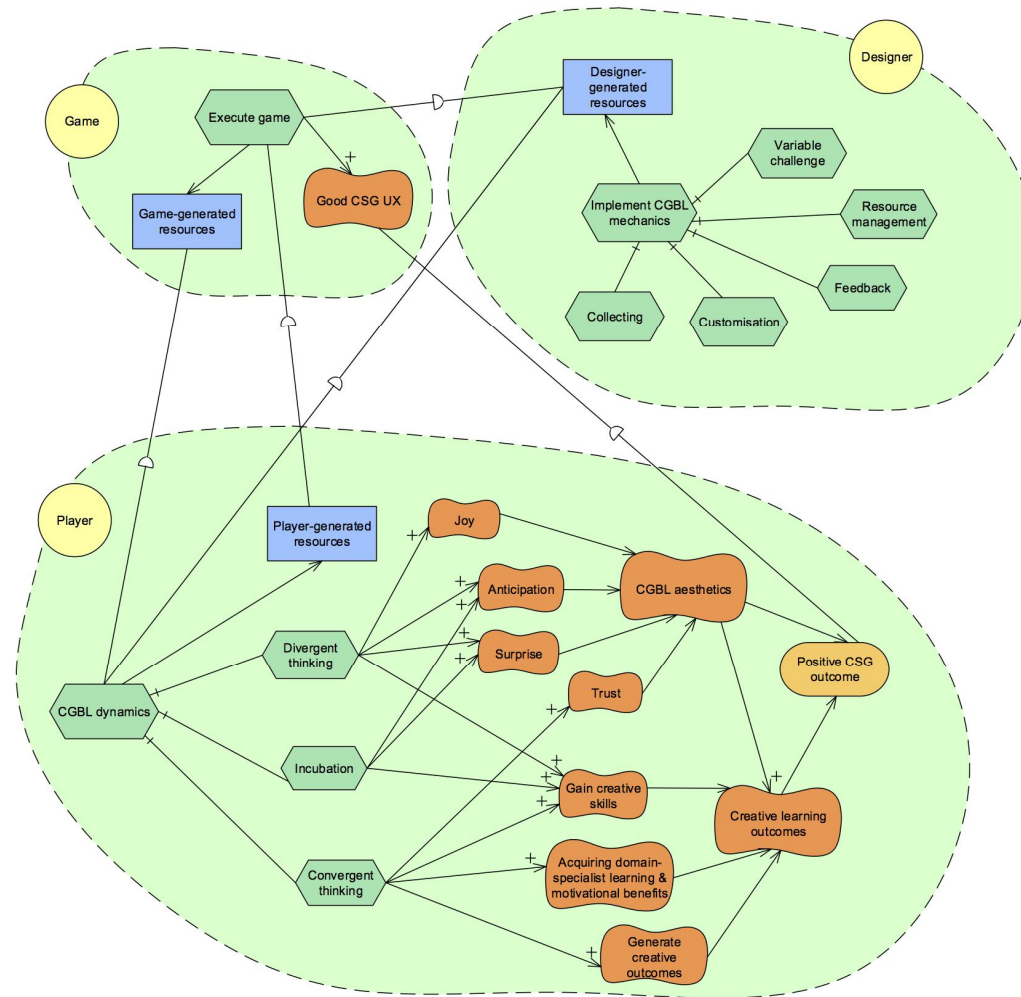
3.3.6 The Integrated framework

The descriptive nature of the CGBL framework benefits from a visual representation that adequately depicts the numerous rich, dynamic dependencies between the individual components of its mechanics, dynamics, aesthetics and creative learning outcomes, as well as the different perspectives of the stakeholders involved. To this end, *i* conceptual goal-oriented modelling framework* was a chosen method because of its ability to represent the rationale of the actors, their goals, know-how and resources for achieving those goals [55, 197]. It is seen as a technique that allows one to express and strategically reason about motivations, rationales, capabilities, qualitative expectations and vulnerabilities of the actors [197]. It affords complex understanding, and often applied to support requirements engineering [55] and knowledge management support tasks [197]. In particular, this conceptual modelling method is effective in the contexts when stakeholders' goals are high-level, abstract and hard to measure [112] - the situation with the CGBL framework.

There are two kinds of models in the *i** framework: Strategic Dependency (SD), and Strategic Rationale (SR) models. In *SD models*, nodes represent actors, and links between actors mean that one actor depends on the other in order to achieve a goal. Between the actors, SD models describe: *hard goal* dependencies; *soft goal* dependencies; *task* dependencies; and *resource* dependencies. Hard goals are binary (i.e. they are either in the state of 'achieved' or 'not achieved'), whilst soft goals can be attained in different ways and are more qualitative in nature (i.e. they are achievable on a spectrum).

The idea of distributed intentionality underlies the i^* framework, answering questions who and why about a system. The *SR model* extends the SD model syntax by allowing modelling inside the actors (i.e. internal composition of goals, tasks, resources, and dependencies). The dependencies within an actor can be *means-end*, *task-decomposition*, and *contribution* links. The diagram in Figure 3-7 summarizes the CGBL framework described in the previous sections, represented as a SR model. Examples of the discussed i^* framework syntax are the following (see in Figure 3-7):

Figure 3-7: The i* SR model representation of the CGBL framework.



The semantics of the model show that the Designer is responsible for the tasks of implementing the CGBL mechanics (Section 3.3.5), which results in designer-generated resources for the game. These are evoked by Game’s execution, which depends on both the Designer’s and the Player’s input. A Player’s input is generated in the process of the CGBL dynamics (Section 3.3.4), when a Player takes part in the creative process, inducing him/her to experience the CGBL aesthetics (Section 3.3.3) and obtain creative learning outcomes (Section 3.3.2), resulting in a positive CSG outcome (Section 3.3.1), which also depends on good CSG user experiences afforded by the Game.

3.4 The chapter summary

The CGBL framework proposal that is presented in this chapter marked the achievement of *OBJ1 (Explore and theoretically describe the relationship between creativity and gameplay for motivated learning by proposing a domain-independent framework for creative game-based learning (CGBL))* and provided the answer to *RQ1 (What are the shared and non-shared characteristics of creativity support and good game design?)*.

The CGBL framework consists of the CGBL mechanics, dynamics and aesthetics, creative learning outcomes and good CSG user experience. These components are further refined, all of which are described in this chapter. The CGBL aesthetics are joy, trust, anticipation and surprise. The CGBL dynamics consists of the facilitation of the creative process steps in a group. Such dynamics allow players to co-create the game, proposing a new

type of player - Creator, in addition to Bartle's player types [12]. The CGBL mechanics are: variable challenge, feedback, collecting, customization, and resource management. The framework has a i* SR model representation.

The literature mapping revealed six shared characteristics between a creative climate and good game design practice: challenge; freedom; trust and safety; humour and playfulness; idea-time and idea support. These dimensions were later implemented in the CGBL framework as a metric for the CSG user experience that guides the implementation of the CGBL Mechanics. The effects of the implementation of the CGBL Mechanics and Dynamics result in Players' experience of the CGBL Aesthetics and creative learning outcomes, and all of these framework components can be evaluated in the scope of an iterative playcentric design process. Part of the framework was validated in the context of motivated learning in person-centred dementia care training, and it is left for future work to investigate its generalisation through instantiation and evaluation in other application domains.

There were lessons learned through the formative evaluations about the empirical process of instantiation of the framework (see Chapters 4 and 5), and in particular concerning design and development the CGBL mechanics and the CGBL dynamics, customised to the requirements of the chosen domain. The summative evaluation (see Chapter 6) mainly focused on the CGBL aesthetics and CSG user experience, whilst creative learning outcomes were only partially addressed in the study.

Each of the individual components of the framework will be defined and explained in the following subsections.

Chapter 4 – Design and Development

“By day he is Woody Allen. But when the night falls and the moon rises, Humphrey Bogart strikes again.”

- Tagline from the film *Play it again, Sam*, 1972

4.1 Introduction

Good game design practice suggests that a game should be tested as early and as often as possible [62, 153]. In an effort to design and develop a prototype that applies the CGBL framework (see Chapter 3) in the domain of person-centred dementia care staff training (i.e. *OBJ2*, Figure 4-1), I conducted a series of user-centred formative evaluations to identify the most appropriate implementations of the CGBL *Mechanics* and *Dynamics* for this domain.

Objective	Question	Outcome
<i>OBJ2</i> : Design one or more customized game prototypes with integrated creativity support that instantiate the CGBL framework in the application domain of dementia care.	<i>RQ2</i> : Which game mechanics, game environment, player mode, artefacts and creativity techniques are the most appropriate to employ in a creative serious game (CSG) that instantiates the CGBL framework in dementia care training domain?	Design and development of game prototypes that instantiate the CGBL framework.

Figure 4-1: Iterative design and development of prototypes that instantiate the CGBL framework was the second objective of this research.

The starting point was the **concept** formulation and evaluation study (Section 4.2). Learning from its results, a **paper-based prototype** was created and playtested in care homes (Section 4.3). This was followed by **two digital prototype developments** and evaluations in the field with care staff users (Sections 4.4 & 4.5). As a result of this feedback, I generated a **final CSG prototype**, *Hazel Court v3.0* (Section 4.6) that instantiated the CGBL framework. The results from these formative evaluations provided continuous and user-centred insights for improving on

OBJ2 and answering the associated *RQ2* (Figure 4-1). The timeline of the studies described in this chapter is presented in Figure 4-2. The Research Ethics Committee of City University London approved the MIRROR project research activities, including all the studies involving human participants in this doctoral research. My role in the MIRROR project was to theoretically describe the relationship between CPS and SGs in the domain of person-centred dementia care, to design CSG prototypes, to manage their development, and to conduct prototype evaluations. In the scope of the project, I collaborated with Imaginary s.r.l., who developed my first digital prototype following my design input, and with NTNU, who developed my final prototype, also following my design input. In the playtesting sessions, I was in one study assisted by a researcher from City University London, Kristine Pitts, and in another study by a researcher from NTNU, Simone Mora. One study was observed by representatives of the Registered Nursing Home Association.

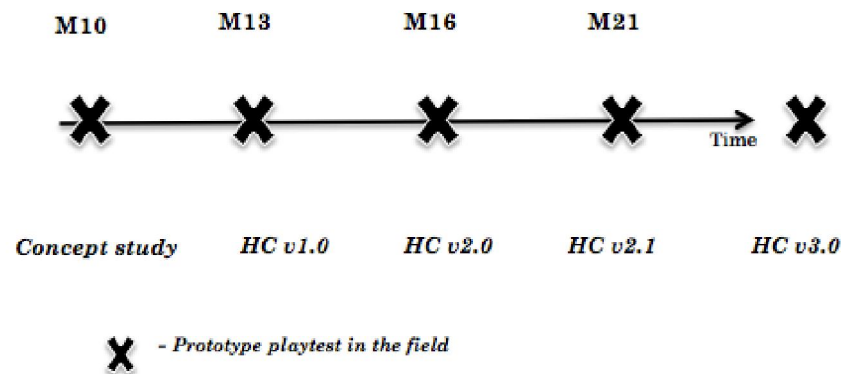


Figure 4-2: The timeline of the *Hazel Court* game prototype design and development process, which included 4 formative evaluations that lead to the final prototype, Hazel Court v3.0. *Mx*, where *x* is for month number, indicates the month into the PhD project when the fieldwork with users took place.

4.2 Concept study

This section reports how the concept for the *Hazel Court* CSG was defined, explored and informed in its early stages using the following methods, listed in chronological order of application in the concept study: i) ethnography (Section 4.2.1); ii) creating a mock-up (Section 4.2.2); and iii) user observation study (Section 4.2.3). Findings from these three activities were triangulated to report on the appropriateness of the concept for the user domain.

These methods were chosen in this project because it provided me, in the role of the CSG designer, with access to multiple data sources to triangulate, strengthening the validity and richness of the conclusions, which is an important factor in an investigation of an exploratory nature [31].

My responsibility in the MIRROR project was to design and playtest the CSG prototypes, and coordinate their development. I had the convenience of sufficient access to participants and resources to support these particular methods through my involvement in the MIRROR project; hence the concept feedback was gained relatively quickly, and further informed my understanding of the main domain users subset (i.e. carers working in RNHA-associated care homes), and the practice of the game development company (i.e. Imaginary s.r.l.) that was to implement my first digital prototype. Early and iterative agreement on the game concept amongst stakeholders is considered good practice in game design [62].

4.2.1 Ethnography

4.2.1.1 *Motivation*

The literature review described my motivation for providing creativity support in person-centred dementia care training (see Section 2.3.2), but further investigation into how the training was typically run was needed. Conducting one small-scale ethnographic investigation allowed me to experience first-hand, in more detail, the basic problem solving skill set that carers are required to adopt in their training, in order to then more empathetically design the creative game-based learning practice for its further developments.

4.2.1.2 *Method*

Ethnography is often used in HCI when trying to understand how to build systems and how users interact with systems [108], especially when applying participatory design [165] to situations where user tasks are not well understood, as in this scenario. The method can be especially effective in participatory design involving understanding how people learn in a particular domain [17], before introducing technology to support it.

To this end, in month M4 of the doctoral research, I participated in a two-day training course for carers, organized by the Registered Nursing Home Association (RNHA) and The Partnership in Care (TPIC) in Ipswich, UK. The course was led by 2 qualified facilitators, hosted about 20 participants and consisted of 13 group exercises on various topics (e.g. ‘Communication’,

‘Nutrition’, ‘End of Life Care’). It was obligatory for all carers starting work at TPIC, regardless of their previous work experience. Participants were mostly female, but differed in other demographic factors and background (e.g. age, ethnicity, first language, level of work experience).

This particular training was chosen on the basis of domain expert recommendation and invitation. It covered a variety of themes related to person-centred care, which provided me with a wider understanding of the carer’s job before selecting a theme to focus on. The training, being introductory, allowed my limited domain knowledge and personal background not to influence the study, which is one of the important considerations concerning this method according to [108]. The facilitated environment allowed me to more easily balance being an observer and a participant, which is another aspect to consider when applying this method [108] - other participants were made aware by the facilitator that I was a researcher, however I participated equally in all exercises, felt welcomed by the group, and used the time in the breaks to enquire informally about their professional experience and problem solving skills. As shadowing carers in their everyday work (i.e. contextual inquiry) would prove a logistic and ethical challenge because of the need to maintain residents’ privacy, taking part in a group training activity (i.e. small-scale ethnography) was closer to the ideal setting for supporting the goal of this investigation. Conclusions from my reflective observation notes, compiled immediately after the session, are summarised in the following paragraphs. No audio/video recordings or photos were captured during the training, in order not to distract participants, and ensure a higher degree of

immersion of the researcher in the training and collaboration with other participants.

4.2.1.3 Results

During one role-play training exercise ('Data Quality & Case Study', Figure 4-3), the aim of which was to equip future carers with information management skills, it was observed that carers were expected to demonstrate detective-like skills when reviewing fragments of evidence in order to diagnose the possible reasons for resident behaviors. These fragments of evidence were collected from personal care plans, observation notes, and statements from carers, residents and family members. Carers were encouraged to create new resolutions to these exercises using problem-solving strategies. That suggested that carers' problem solving would sometimes necessitate creative thinking that focused on **gathering, exploration and management of diverse information sets (i.e. divergent thinking support)**, to initiate **flexible and innovative decision-making based on those activities (i.e. convergent thinking support)**. As already emphasised in the discussion of related research in the literature review, such approaches to resident care can make a difference in person-centred dementia care (see Section 2.3.2), where one often has to cross-examine gathered information due to residents' cognitive condition. In that way, carers can build understanding of a resident's issue on the basis of its causes and implications, and use it for generating a creative resolution.



Figure 4-3: Materials used in the ‘Data Quality and Case Study’ exercise, given to the researcher with permission of TPIC, the owner of the materials: fictional residents’ Care Plan, task instructions and scenario, additional handouts related to the Data Quality theme - all of which was text-only. Excerpts were examined and discussed in a group, and then used for generating new resolutions to the task.

During groupwork conversations with the other participants in the training, I also observed the **importance of collaboration and teamwork** in these problem-solving activities that could benefit from staff empowerment and professional development [30]. Some of the members of my group happened to be experienced carers, and I learned a lot from reflections that they spontaneously shared in a conversation triggered by the exercise materials. All group members contributed their views, shaping the discussion and often providing it with new valuable conversation directions, more than in any other of the exercises.

Moreover, it seemed that the most of the participants in the training enjoyed the challenge of this particular exercise and the challenge of solving the care home mystery scenarios (i.e. subset of problem solving tasks). It seemed to allow them to step out of the more traditional demands of their role for a moment, and approach the task of resolving challenging behavior of the residents in their care in a more playful way, in comparison to reproducing factual solutions they read in a textbook or on a presentation slide.

From these findings, I concluded that a **detective-themed multiplayer CSG** could be not only a compatible, but also an engaging concept to start exploring as a narrative setting for hosting the CGBL mechanics and dynamics in the domain. The ethnographic study therefore provided the foundation for the new game concept. As I concluded from my observations, the detective world would be an appropriate analogical platform for creative game-based learning groupwork, where information clues are gathered, examined, discussed and used for problem solving in the context of person-centred care.

4.2.2 Creating a mock-up

4.2.2.1 *Motivation*

In order to embody the concept of the detective theme that corresponded with its operations to the original challenge of the dementia care training problem domain, I created a game mock-up, set in a parallel world of detective investigation. Ethnography suggested that carers should develop diagnostics skills for

understanding residents' actions and emotions, in the context of its causes and implications. Reasoning in such a way often requires reconstructing events by managing information from both personal and other people's reflections and various data sources, similar to a detective solving a case.

Therefore, the mock-up game was designed to be a *mash-up* (i.e. a system that combines functionality and/or data from more than one source) between: i) the popular commercial detective game of *Cluedo* [190], where in order to solve the murder of Mr Black, players try to find out who the murderer is among his party's guests, what the murder weapon was, and in which room the murder was committed; ii) the *Choose-your-own-adventure* [79] instantiation of *Variable challenge* mechanics, where players make a series of choices that influence the narrative; iii) creativity technique of *Other worlds* [129], integrated to employ a direct analogy between the detective world on one side, and carers resolving challenging behaviours of residents on the other.

There were several game mashups of *Cluedo*, e.g. *Wizard Mansion* [191], where players are wizards in a mysterious mansion (the *Cluedo* board), trying to collect all the magic weapons while casting spells and counter-spells on each other; and *House Of The Revenge Of The Murdered Dead* [191], where the aim of the game is to solve a murder in a house (the *Cluedo* board) being over-run by zombies. In my mashup, there are no zombies or wizards - only distressed residents, and the game objective of carers is to build up a story of resolution whilst engaging in creative learning about person-centred care.

4.2.2.2 *Method*

The mock-up was developed during my 1-week visit in month M5 of the project to a serious game company Imaginary s.r.l. in Milan, Italy, where I had a chance to develop the ideas raised by my ethnographic observations, and present them to several product managers who gave their feedback on the concept. The mock-up was therefore mainly used as a conversation tool, a form of an informal design probe, with an aim of communicating my CSG concept in a format that is standard in game design practice [62].

The mock-up was documented as a set of wireframes created in PowerPoint, under a working title *Carer Cluedo* (Appendix A-1).

4.2.2.3 *Results*

In the resulting game mock-up, players are transported from Virtual Care Home [143] to a parallel mystery world, where they choose an adventure in which they solve a puzzle about a missing resident. The final objective is to create a story of one's solution to the puzzle (structured by: Location – where is the resident now?; Motive – why is she missing?; Suspect – who is 'guilty?'). The story solution was to be person-centred in relation to the missing resident, built on the baseline of collected clues that shed light on the events' background.

To this end, players rely on a Cluedo-inspired whiteboard, where they collect, explore and examine the clues set by the game

(Figure 4-4). An integrated digital tutor (see Section 2.3.2), who helps players by prompting discussion about the clues, accompanies players in their investigation. Players also have access to a notepad, where they can keep record of their ideas, similar to *Cluedo*. As a challenging constraint that provides a win/lose condition, they have a limited number of tries in solving the puzzle, but more than one combination (Location-Motive-Suspect) can form an acceptable story solution of the puzzle.

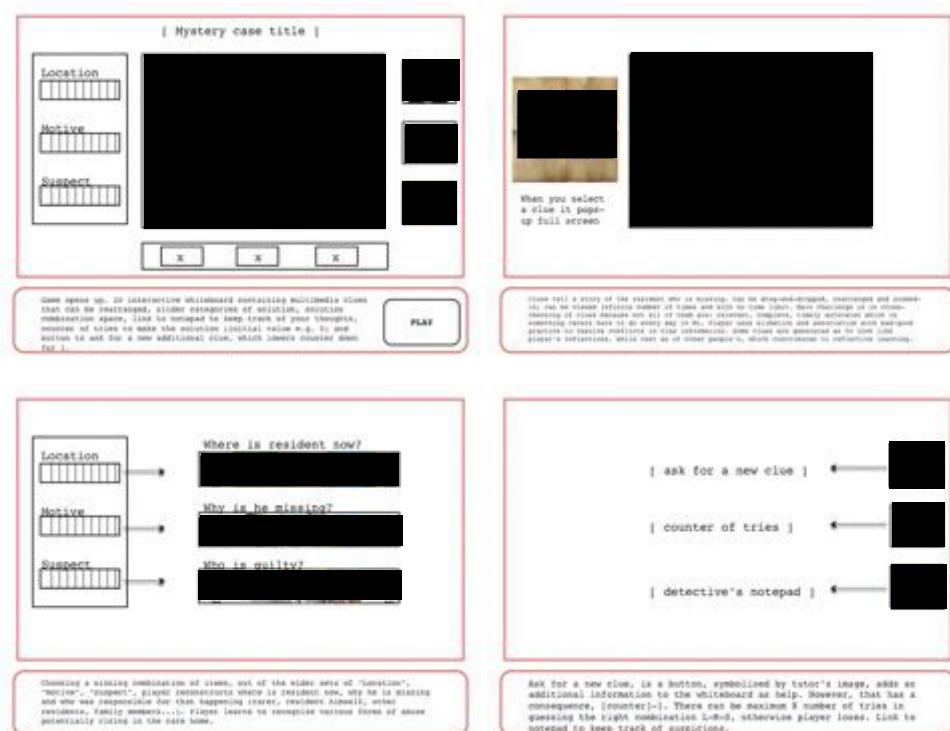


Figure 4-4: Wireframe from the mock-up, depicting the Cluedo-inspired whiteboard with clues (top left). Clues could be zoomed in and shuffled (top right). Location-Motive-Suspect combination gives structure to the story players create about the missing resident (bottom left). A tutor, try counter and notepad are there to support the mechanics of *Feedback*, *Variable challenge* and *Customisation* (bottom right). See the full set of wireframes in Appendix A-1.

The clues are presented as information sources, equivalent in form to ones that a carer usually has in his mind when dealing with a problematic situation, supporting the technique of *Other worlds*:

- video – interviews/talks with another carer/resident/other resident/family member;
- text – pieces of information resembling form of care notes and care plans;
- pictures – items related to resident’s personal history or some previous event that can evoke an association.

Players have to be attentive because not all the clues are correct, timely, complete or relevant, as often happens in real life practice. Therefore, players have to resolve what really happened to cause challenging behaviour by doing constant cross-examination, elimination and association with good or bad practice, like in detective work. The tutor is there, like colleagues/managers in real life, to support the players in their divergent and convergent thinking when problem solving.

The mock-up proposed, on an abstract level, instantiation of the CGBL mechanics (Figure 4-5): *Resource management, Collecting, Customisation, Variable challenge, Feedback*.

The mock-up was used in the discussion with the product managers, and after gaining their approval of the concept, the tentative roadmap of the game development was created (Appendix A-2). The roadmap defined requirements from both the developers and the designer in relation to the mock-up wireframes in case the mock-up was to be developed to a

prototype. In conclusion, creating a mock-up helped to explore the concept's foundation and give structure to the CGBL mechanics instantiation in the context of the game concept, and this process was enriched by the developers' perspective.

Mechanic	Proposed instantiation by the mock-up
<i>Resource management</i>	Managing, exploring, combining and cross-examining the clues on the whiteboard
<i>Collecting</i>	Collecting clues
<i>Customisation</i>	"Choose your adventure" mechanics, notepad
<i>Variable challenge</i>	Solving the puzzle of the missing resident in the Other world; counter
<i>Feedback</i>	Tutor integrated in the game prompts the discussion amongst players

Figure 4-5: Proposed instantiation of the CGBL mechanics by the mock-up.

4.2.3 User observation study

4.2.3.1 *Motivation*

A formative within-group concept evaluation was conducted to further investigate whether the posing of detective-style mysteries as a narrative setting in a form of the *Other worlds* creativity technique [129] could be effective in training dementia carers to face their problem solving challenges. The focus was on observing:

- Domain users' interaction with a physical game environment in a professional setting;

- The appropriateness of a detective world as implicit creativity support, implementing *Variable challenge* in this domain;
- Participants' approaches to person-centred problem solving.

To this end, I introduced a commercial detective board game called *221B Baker Street* based on the fictional adventures of Sherlock Holmes in Victorian London as a prequel task to a real-life carer training exercise. I could not use the game mock-up I created, because it did not provide playable functionalities, and I did not want to invest resources in an implementation before the concept was further informed by the domain users' feedback. Therefore, using a slightly simplified commercial game that implements some of the CGBL mechanics, was assumed to be a suitable probe.

The assumption based on the literature on creative learning (see Section 2.2.3) was that the CGBL aesthetics and creative learning outcomes experienced during the detective game play (see Sections 3.3.2 and 3.3.3) in the first activity would transfer in such a way as to encourage participants to be more open-minded, perceptive, engaged and inquisitive in the second activity. In this second activity, carers were put in the role of a care home manager who received an anonymous safeguarding referral about a resident who was reported to behave in an unusual way lately and abuse was suspected. The task was to investigate these allegations based on available evidence from life histories, carer notes and staff interviews.

4.2.3.2 *Method*

The study involved two groups of three carers and activity organisers, and was hosted by Forrester Court, a *CareUK* residential care home in London that volunteered for participation via a call that was distributed on my behalf across the *My Home Life* network (Appendix B-1). The structure of the study was as follows:

1. *Playing '221b Baker Street'*: This commercial boardgame (Figure 4-6) has a *Cluedo*-like board and the players' goal was to solve a mystery described in a case scenario, by collecting and putting together the clues and subsequently finding answers to posed questions (in the case used, 'The Adventure of the Unholy Man': identifying Killer, Weapon, and Motive). Similar to *Cluedo*, the rooms on the board were navigated by tokens in order to collect information about the case, and the movement of the tokens was determined by throwing a dice. The information was given in the form of textual clues provided in a booklet. By cross-checking and managing this data, players arrive at a solution to the case puzzle. According to the game rules, this process is supposed to be done individually, but for the purpose of simplifying the exercise, participants were instructed to collaborate and share their findings.



Figure 4-6: 221b Baker Street board, case scenario, notes, booklet.

2. *A role-playing exercise:* The goal of this exercise was to put the participants in the role of a care home manager, who has received an anonymous safeguarding referral via email. The task was to investigate these allegations. Available clues and evidence were excerpts from life histories, carers' notes and staff interviews. The materials used in this exercise were adapted from the materials used in the ethnographic investigation (see Section 4.2.1.3).

The collected data consisted of audio recordings, photos (Figure 4-7) and my observations in written notes. All of the material used in the study was piloted beforehand in a lab setting. Participants signed the informed consent forms (Appendix B-2) to allow gathering and analysis of data for research purposes, and were provided with an explanatory statement about the project (Appendix B-3). Participants were of various ethnic backgrounds, and differed in terms of the lengths of work experience, age, and level of English language proficiency, as observed in the

ethnographic study. One session lasted up to 90 minutes, and consisted of: 60 minutes of playtesting and role-playing; and 15-30 minutes of a guided debrief discussion (questions provided in Appendix B-4). The formative questions aimed to prompt a discussion (e.g. *How did it feel playing ‘221b Baker St’ at your workplace today?; In your experience, to what extent is dementia care like detective work?; How do you usually face problem solving in your everyday professional work?*).



Figure 4-7: Photos from one of the concept study playtests, showing carers playing *221B Baker Street* game (left), and doing the role-playing exercise (right).

4.2.3.3 *Results*

The observation results suggested that the use of the game was not as effective as anticipated, in that both groups of carers were neither able to solve all of the detective mysteries in the game, nor were they able to transfer knowledge and skills from that other world to the dementia care training. The primary reasons identified included the game being too complicated for the carers to play (*“I wish the game objective was clearer and we had more time”* - P1S1), and the semantic distance from it to dementia care

being too great. The carers seemed to have a problem with connecting the purpose of two parts of the game (i.e. playing 221b Baker Street, and role-playing exercise), and might have felt inadequate as a result. In particular, one participant was dismissive towards the idea from the beginning (*"I don't have passion for boardgames"* - P2S1). Even when participants collected all the clues, they would find themselves stuck, suggesting the need for a more structured creative problem solving support integration, which would support individual creative process stages. On reflection, the language used in the clues should have been presented in a more simplified way, and in bigger font (i.e. small letters in the game's props were a problem, especially for older participants).

In contrast, the playtest did indicate the importance of physical board game elements familiar to most people from childhood to foster communication, collaboration and play. One group in particular emphasised they would *"prefer a combination of physical and digital, rather than just physical or just digital"* (P1S1) in the interface of the game, making the game environment tempting to explore and more accessible at different levels.

The winning condition was discovered not to be an incentive for divergent thinking, because it made participants already take it 'seriously' and as problem solving in a professional context, which might prove to be an obstacle in achieving the CGBL aesthetics of *Trust*. However, both groups spontaneously chose to play the game/undertake the role-play exercise as a team, instead of competing and playing against each other. One of the reasons for

this could be, as one participant said, was that it is “*easier in a team when you are new with the game*” (P2S2). One group strongly agreed that they “*enjoy more solving problems as a team than as individuals*” (P3S2).

A need for a creative learning component was indicated and welcomed. As one participant said, “*a game whose mechanisms depend on knowledge, rather than luck*” (P1S1) seems engaging. After both exercises, all participants seemed convinced that developing an understanding of the residents is an important objective, but the initial motivation to engage is missing, since they are usually not required to do it in everyday work; as one participant said: “*most of person-centred care is on paper, rather than happening in practice*” (P3S1). Another participant (P2S1) noted that playing this kind of a game thought her “*not to judge the book by its covers, but to really try to understand what is going on, and doubt everything, and find out why*”; “*dig through their background*”; which seems to support a designer’s intention to increase players’ perceptiveness through a detective theme concept.

These initial results were somewhat expected, because an adaptation of a commercial boardgame was used, rather than a CSG prototype customised for the domain. A design challenge was therefore to attempt to embody the concept that is accessible as an engaging CGBL training tool to both gamers and non-gamers. Therefore, the playtest revealed the need to provide a simpler detective game that employed the creativity technique of *Other worlds* that is semantically closer to the dementia care domain to better facilitate knowledge transfer.

In summary, the user observation study introduced a real-world domain users' perspective on person-centred care problem solving to the game concept. These early-stage results explored the appropriateness of a physical game environment and the *Other worlds* creativity technique in instantiating *Variable challenge* in resident care setting. The conclusions are further summarised in Section 4.2.5.

4.2.4 Threats to validity

In the next subsections, I review the threats to validity that were identified for each of the three methods applied in the concept study.

4.2.4.1 *Ethnography*

Other exercises in the training that I observed and took part in might have inspired different concepts, and it is an important limitation to address. The designer of a CSG may choose to create several concepts and evaluate them. Also, other designers might have generated different concepts inspired by the same exercise. Designers taking part in ethnographic investigation will, to a certain degree, bias the outcome concept design; but a higher level of empathy with and understanding of the users is gained. In my case, the rationale presented in the literature review, supported by further exploration of the concept with other methods, together served to establish and refine the proposed concept. In the end, it was left to a designer to define the concept with the strongest

appeal, though based not only on personal experience from the ethnographic investigation, but also on the observed prospective users' behavior and feedback, and related work.

4.2.4.2 *Creating a mock-up*

The mock-ups supported communication of the game's structure and main functionality. However, a mock up is not a working prototype that actually implements mechanics to any degree, and that imposed a limitation on the scope of the study. Whilst creating the mock-up provided opportunities to further refine and explore the concept, it was necessary to inform the concept with domain user feedback before venturing on implementation. There was still an open question about whether carers would endorse the *Other world* of detective investigation and its mechanics as the core of the CSG concept in their professional setting, and that issue was addressed by the preceding user observation study.

4.2.4.3 *User observation*

The sample in this study was too small to draw any general conclusions, and therefore the findings are to be treated with caution due to participants' bias (i.e. not only small in numbers, but also narrowed by the fact that the both groups were from the same organization). However, being part of the concept's formative process, it provided me, in the role of a CSG designer, with some valuable initial feedback about the core creativity support implemented by the game's mechanics. Furthermore, visiting a care home for the first time helped me to build a wider

sense of the organisational climate and the constraints of fieldwork in this domain.

4.2.5 Conclusions

By combining the methods of ethnography, prototyping and user observation, the concept for a CSG to support training in person-centred dementia care was successfully defined, explored and informed (Figure 4-8), in collaboration with several different stakeholders. The emerging concept proposed a detective-themed game, a *Choose-your-own-adventure*, *Cluedo* mashup for carers, which with its mechanics supports *Other world* creativity technique.

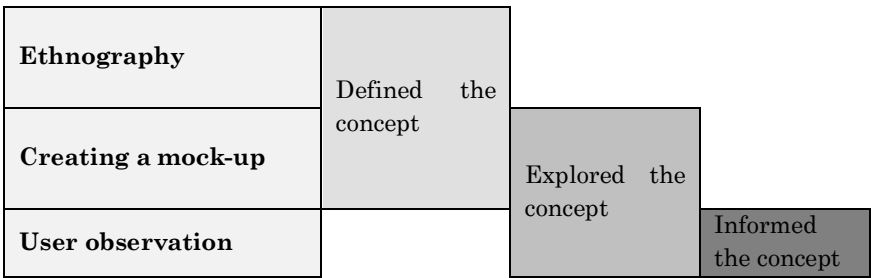


Figure 4-8: The contribution of the individual methods applied in the study to the CSG concept design.

In summary, the five main recommendations *R1.1-R1.5*, achieved by triangulating the results from the analysis of the three methods were:

R1.1: The proposal to use the *Other worlds* technique is effective as an implicit creativity support of the game environment, but CSG design requires other, more explicitly

implemented creativity techniques to be supported by the mechanics instantiation in order to provide more structure to the CGBL dynamics (i.e. the creative process);

R1.2: Implementation of the mechanics and designer-generated resources needs to support case scenario contents that are semantically closer to the user domain;

R1.3: Implementation of the mechanics and designer-generated resources needs to support case scenario contents that are clearly formulated and presented, and not too dense with information. This will allow freedom for creativity and interaction amongst players to emerge; otherwise, they may end up being too busy inspecting resources rather than building on them;

R1.4: Teamwork in a multiplayer training setting proved to be a significant component of engagement in this domain, and is also something to be encouraged by the mechanics;

R1.5: In order to support the CGBL dynamics, mechanics should be implemented in a way that combines physical and digital resources.

4.3 Hazel Court v1.0

The next phase in the CSG design, according to good and iterative playcentric design processes [62], was to embody:

- the set of CSG user experience goals (see Section 3.2);

- dynamics (see Section 3.3.4);
- mechanics (see Section 3.3.5);
- the brainstormed concept;

into a *physical prototype* that would be playtested with domain users before venturing onto digital prototyping.

To this end, a physical prototype implemented the lessons learned in the concept study, and provided an opportunity to get feedback on the dynamics of the game, which could not have been considered with a mock-up. The resulting prototype was named *Hazel Court*, after the fictional name of a residential care home in which the game world was situated, and it was playtested in care homes in month M13 of the project.

This section is reported in four parts: i) the introduction of *Hazel Court v1.0* CSG through its basic formal game design elements [62]; ii) the description of the implemented mechanics in *Hazel Court v1.0* that aimed to instantiate the CGBL framework; iii) the intended dynamics in *Hazel Court v1.0* that aimed to instantiate the CGBL framework; iv) the playtesting of the physical prototype, resulting in the recommendations for the next design phase.

4.3.1 Design overview and physical prototyping

4.3.1.1 *Premise*

Expanding on the concept of a detective-themed CSG for dementia care staff training (see Section 4.2), *Hazel Court v1.0* adapted the game world of *Cluedo* for creative learning about

person-centred care. The game aimed to integrate a direct analogy between the elements of *Cluedo* and carers' practice, in order to set the narrative of the *Other world* where players would collaborate to make and justify their choices while solving a mystery, and creating their own storyline resolution. There was no time limit to the game, although each play was expected to last 30-40 minutes. The game was intended for groups of 2-5 care staff players in a training setting.

In order to support the *Trust* and *Idea-support* dimensions of a good CSG user experience (see Section 3.2), the focus is on multiplayer cooperation. Such cooperative play does not involve the *Conflict*-supporting mechanics of beating an opponent or the game, for the reasons explained in Section 3.2. Some examples of games supporting cooperative play are popular commercial games such as: *Journey*, where players travel through a mysterious world and communicate with fellow travellers by singing a single note, conveying ideas and forming relationships [202]; and *Portal 2*, where players have to find creative ways to solve the levels together [203].

Hazel Court v1.0 is introduced to the players with the following paragraphs, which considered the importance of gradual bridging of the gap between the domain and the *Other world* (see *R1.2* in Section 4.2.5) and clearer communication between the game and the players (see *R1.3* in Section 4.2.5):

What is the difference between being a carer and being a detective? Not as much as most people think...

It is another fine day in Hazel Court care home. Discover where the story takes you as a team. Make the choices and face the challenges, but remember there are no right or wrong answers in this game.

The goal is to get your creative juices flowing and learn from each other's experiences. Listen to the ideas of others, and if their ideas spark an idea for you – give them credit.

In the next step, each of you will get a role to play. Keep your eyes open for the clues in the rooms of Hazel Court and have fun!

4.3.1.2 Challenges

In the game of *Cluedo*, Dr Black has been murdered, and the challenge is to solve the crime by working out who the murderer is, what weapon was used and where the crime was committed. Instead, in *Hazel Court* CSG, the challenges for the players are to:

- Investigate the unusual behaviour of two residents of *Hazel Court*, called Mr and Mrs Black;
- Speculate the reasons behind the mysterious behavior of the Blacks;
- Collaboratively create a solution that will engage the Blacks in a meaningful, person-centred activity based on those findings.

4.3.1.3 Outcome

The outcome of playing *Hazel Court v1.0* was intended to be a positive CSG outcome for the care staff participants, as defined by the CGBL framework: it is achieved if the players experienced at least one creative learning outcome and one CGBL aesthetics during the CSG's dynamics.

4.3.1.4 Characters

The characters of *Cluedo* - guests of Dr Black in his country mansion, were mapped to the stakeholders of the care home *Hazel Court* (Figure 4-9) in a way that supports the relationship-centred model of person-centred care [137].



Figure 4-9: The characters of *Cluedo* are mapped to carers, fellow residents and family members of two residents, the Blacks, in *Hazel Court* care home. Figure shows classic *Cluedo* character cards' graphics mashed-up with *Hazel Court* contents, in screenshots from the prototype prompts.

This design choice was made in order to bring the game's *Other world* semantically closer to the domain users (see *R1.2* in Section 4.2.5), yet aiming to remain playful due to keeping familiar associations with the popular detective game.

4.3.1.5 Resources

There are 3 types of designer- and game-generated resources in *Hazel Court v1.0*:

- **The *Cluedo* game set:** Along with the characters, the *Cluedo* board is used – *Hazel Court* had the same two-dimensional layout as the country house described on the *Cluedo* board (Figure 4-10), containing nine rooms, which may also be found in a care home: *Study, Ballroom, Dining Room, Kitchen, Hall, Billiard Room, Library, Lounge, Conservatory*. *Hazel Court v1.0* in its dynamics also utilized the figurines of *Cluedo* weapons (Figure 4-10);



Figure 4-10: The *Cluedo* board (left) and weapons figurines (right), used as resources in *Hazel Court v1.0* dynamics.

- ***Hazel Court* narrative and clues:** In each of the rooms, there may be a clue (Figure 4-11), or a character, who can offer a clue or pose a choice (Figure 4-12), or a creativity prompt (Figure 4-13). For example, after being introduced to the game and getting to know the characters (see Section 4.3.1.3), *Hazel Court v1.0* dynamics start with the following clue that players find in the room *Hall*, which is the start position of the game: *There is a rumour going around Hazel Court that Mr and Mrs Black have been acting rather unusually lately. You're curious, so you want to talk to other people about it. You want to finish your investigation before lunchtime, so you need to kick off now. Where will you go?;*



Figure 4-11: Physical prototype resources - The clues hiding in the rooms of Hazel Court.



Figure 4-12: Physical prototype resources - the clues provided by the characters that appear when players explore different rooms of *Hazel Court v1.0*, also presenting the choice of where to go next.

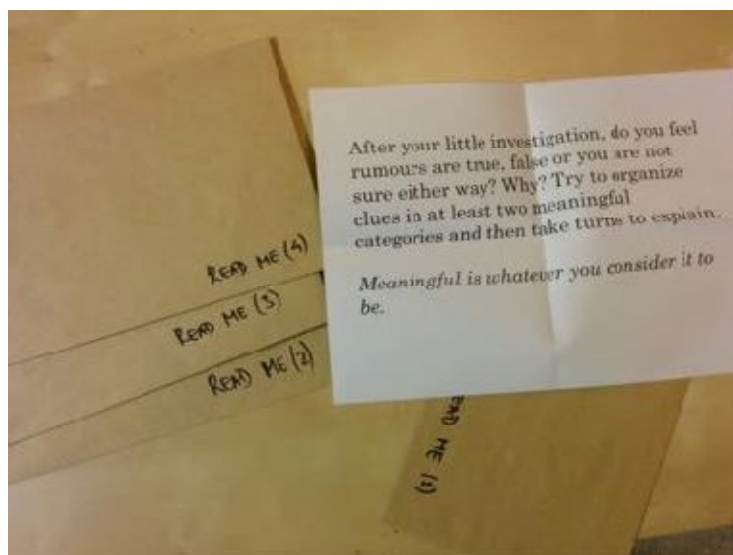


Figure 4-13: Physical prototype resources - the 'read-me' envelopes that provided creativity prompts in *Hazel Court v1.0*.

- **Stationery material:** The stationery was needed for recording and externalising ideas, e.g. post-its, flipcharts, pens, markers, and blue tac.

4.3.2 Mechanics

The mechanics of *Hazel Court v1.0* (Figure 4-14) expanded the design of mechanics from the mock-up (see Section 4.2.2.3), by exploring and relying on the design recommendations from the game concept evaluation (see Section 4.2.5). Each of the re-designed mechanics is discussed in turn in the following subsections.

4.3.2.1 *Variable challenge*

As a means to instantiating the *Variable challenge* mechanic, I decided to continue to provide implicit creativity support. However, I used the lessons learned from the concept study (see *R1.2* in Section 4.2.5) to introduce improvements. The *Other worlds* creativity technique [129], in which carers play the game in a domain analogical to dementia care, in this version is differently constrained by the game narrative elements (e.g. storyline, characters) in order to better support creative thinking and CSG user experience. By modifying the game resources and their utilization, I altered the type of detective domain to be semantically closer to dementia care problem solving, and made the game simpler to play (Figure 4-14).

4.3.2.2 *Resource management, Customisation & Feedback*

In addition to implicit creativity support, the *Hazel Court v1.0* game explicitly deploys adaptations of three established creativity techniques, in order to support the ideation part of the creative process (see Chapter 2) [162], as the need for it was recognized in the concept study (see *R1.1* in Section 4.2.5):

1. The *brainstorming* technique for exploratory creativity (i.e. searching for a problem solution by exploration within a conceptual space), in order to support the generation of ideas about improving care in the residential home. Brainstorming is a technique that involves spontaneous contribution of a large number of ideas or associative elements by all players [129] in short time, related to a defined problem statement or a question.
2. The *random combinations* technique for combinational creativity to combine ideas generated by different people during the brainstorming. This technique is based on a finding that problem solutions often come as combinations of associations and stimuli in the environment, and as such are considered serendipitous [126].
3. The *excursion* technique [129, 166] for transformational creativity (i.e. searching for a problem solution by transforming solutions from another conceptual space), in order to support the generation of ideas by viewing the world from different perspectives through role-play. The technique encourages players to draw analogies or express relationships between what they saw on the excursion to

Hazel Court and the care-related problem statement, to reflect on them and to discuss possible applications in the real world.

These creativity techniques were implemented to complement phases v) Generate ideas, and vi) Combine ideas, from Sawyer's model (see Section 2.2.1.4), supporting players in creative thinking towards person-centred care solutions. Each technique directly engaged players in creative teamwork (see *R1.4* in Section 4.2.5). This addition to the game's dynamics provided new ways to employ the mechanics of *Resource management*, *Customisation* and *Feedback* (Figure 4-14).

4.3.2.3 *Collecting*

The prototype was designed with an implementation of the *Collecting* mechanic that was an effort towards a more pervasive CSG, which turns the environment into a playable space that is controlled by the players rather than the game borders. As such, it was not restricted to its boundaries, but involved spaces and objects in the environment in which the game is played during a treasure hunt (i.e. objects were hidden and to be found within the actual room where the session is taking place), thereby connecting the playing of the game more closely to the care environment. The clues were to be collected physically, whilst it was considered to introduce some digital elements in the clues *Collecting* in the next game version to eventually provide even more pervasive experience (see *R1.5* in Section 4.2.5). Furthermore, when implementing the clues for collecting, attention was paid towards

the information representation, clarity and structure that would provide challenging but manageable quests for the players (see *R1.3* in Section 4.2.5).

Mechanic	Instantiation in <i>Hazel Court v1.0</i>	Creative process stages supported by the mechanic
<i>Resource management</i>	Managing, exploring, combining and cross-examining the clues collected in the rooms of Hazel Court and the ideas that are generated;	ALL
<i>Collecting</i>	Collecting clues in the rooms of Hazel Court; treasure hunt	Divergent thinking
<i>Customisation</i>	“Choose your adventure” mechanic when deciding where to go next when navigating the board; players generating ideas based on the clues and their own input, and creating their own solution to the puzzle;	ALL
<i>Variable challenge</i>	Solving the puzzle of the distressed Blacks in the <i>Other world</i> of <i>Cluedo</i> ;	Divergent thinking
<i>Feedback</i>	Creativity prompts help to structure the idea development discussion amongst participants.	Convergent thinking

Figure 4-14: The mechanics of *Hazel Court v1.0*, and the corresponding creative process stages they intend to support in the dynamics.

4.3.3 Dynamics

The game was divided into three levels, corresponding to *the CGBL Dynamics* stages of *divergent thinking* and *convergent thinking*. The *Incubation* stage was not implemented, due to lack of exposure time with participants, as incubation often requires a distance in both time and environment [89]. Each level was expected to be played sequentially, but variations were allowed by the mechanics.

- ***Divergent thinking using card clues:*** In the first level of the game, each player played the role of a different character in the home and moves about the home investigating evidence. This part was played on the *Cluedo* board (Figure 4-10). The players moved around this board from room to room and explored the different options of a storyline initially composed of 8 possible scenarios, depending on their choices, guided by clues (Figure 4-11) and character statements (Figure 4-12) provided in physical envelopes. The game did not impose any right or wrong answers or assessment of the input generated by the players.
- ***Divergent thinking using object clues:*** In the second level of the game, all of the players were given a mini-game task in the physical space in which the game was being played. As a team they were prompted to engage with this environment by searching for physical objects represented by the types of weapon provided in the *Cluedo* game (e.g. rope, candlestick) (Figure 4-10). This stage was used to explore carer reactions to an invitation to search and explore their own environments.
- ***Convergent thinking:*** In the third level of the game, the players were provided with *read-me* envelopes containing explicit guidance for combinational creativity and debrief questions in the format of the storyline. These were focused on the domain and the puzzle, and therefore induced players to start with convergent thinking (Figure 4-13). Using post-its and a flipchart, they were asked to

brainstorm ideas from the point of view of their character in the story about how to improve the care of Mr & Mrs Black using the clues and other information gathered during the game. Afterwards they were asked to reflect on situations when they considered their work to be detective-like, and to share these situations. Finally, to support knowledge and skills transfer from the game environment to their own work environment, they were requested to discover a Mr & Mrs Black in their own residential home (Figure 4-15) and discuss the implications of that transfer. Some of these activities have elements of divergent thinking (e.g. brainstorming), but are explicitly convergent by the game towards the problem domain.

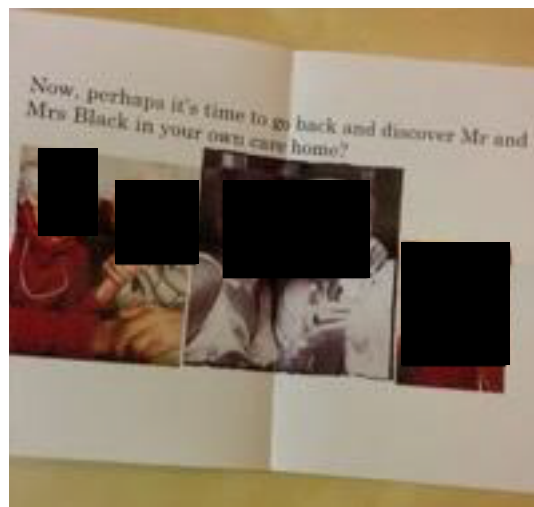


Figure 4-15: A narrative prompt supporting the transfer of knowledge and skills in *Hazel Court v1.0*.

The flowchart in Figure 4-16 shows the levels of the dynamics and the process path that players were expected to take during the game. Some variations were expected, especially in the third level, which was the least constrained.

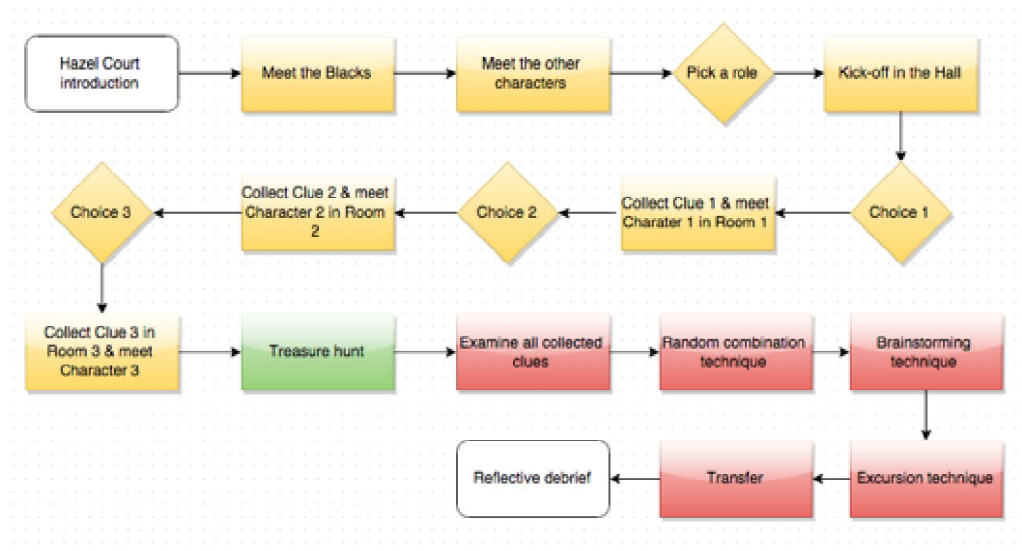


Figure 4-16: A flowchart showing the dynamics of Hazel Court v1.0 and its three stages: divergent thinking using card clues (yellow); divergent thinking using object clues (green); convergent thinking (red). Choices signify decision-making points (i.e. ‘where do you go next?’).

4.3.4 Playtesting

The purpose of a physical prototype is to allow the game designer to evaluate a small subset of game mechanics or features. A physical prototype can be constructed quickly and at low-cost, without a need to represent full array of functionality, graphics, or resources [62]. Formative evaluation of the physical prototype allows domain users, who are non-technical stakeholders, to effectively give their input at a high level in the design process. Most importantly, as the term ‘formative’ indicates, this kind of playtest allows the designer to refine the mechanics and the design elements (i.e. input and process) without any testing of the game’s outcome (i.e. measuring output), before venturing on the next step in the development of a CSG.

4.3.4.1 *Motivation*

The objectives of this playtest were to formatively evaluate the physical prototype in the field with domain users, by:

- Observing how the players interact with the design elements during the different levels of game dynamics;
- Observing the functioning of the CGBL mechanics and looking for input for their refinement;
- Investigating the overall appeal and interest levels amongst domain users;
- Investigating the overall challenge level amongst domain users;
- Investigating the overall understanding of game's features amongst domain users.

4.3.4.2 *Method*

The method used for the formative evaluation was user observation in the field, without any active participation from the researcher side apart from distributing the game resources (i.e. envelopes, cards, prompts on the paper, stationery). At this stage, it was important to allow the players to try the game with minimal intervention in order to record genuine interaction results.

A playtest of the paper-based prototype of the *Hazel Court* game took place at two care homes from *Life Opportunities Trust* network of private care homes, in Kings Langley, UK (Figure 4-

17), in month M13 of the project. The participants volunteered their time for the evaluation via a call that was distributed on my behalf across the *My Home Life* network (Appendix B-1).

There were a total of four playtests in the field planned, two per day, each involving three carers, who have worked together and known each other from before, having between one and three years work experience within the organization, and aged between their mid 20s and mid 40s. The collected data were audio recordings, photos of the session and my written notes. Each playtest was planned to last about 45 minutes, and was structured according to the Fullerton's guidelines on conducting a playtest session [62] in the following way:

- *Introduction (2-3 minutes)*: Welcoming the playtesters, thanking them for participation, introducing myself and the project, playtesting process and explaining how their feedback will help me to improve my design. Agreement was sought on informed consent and understanding of explanatory statement (adapted forms disclosed in Appendix B-2 and B-3, respectively).
- *Warm-up discussion (2-3 minutes)*: Asking questions to find out whether they had played *Cluedo* before and what kind of games they like to play.
- *Play session (30 minutes)*: Explaining to the playtesters that they were trying a game that was still in development, and that I was testing the game rather than their skills, and they were asked to "think out loud" as they played.
- *Debrief (5 minutes)*: Asking what went well, what went wrong, and if they had any suggestions for my future work.

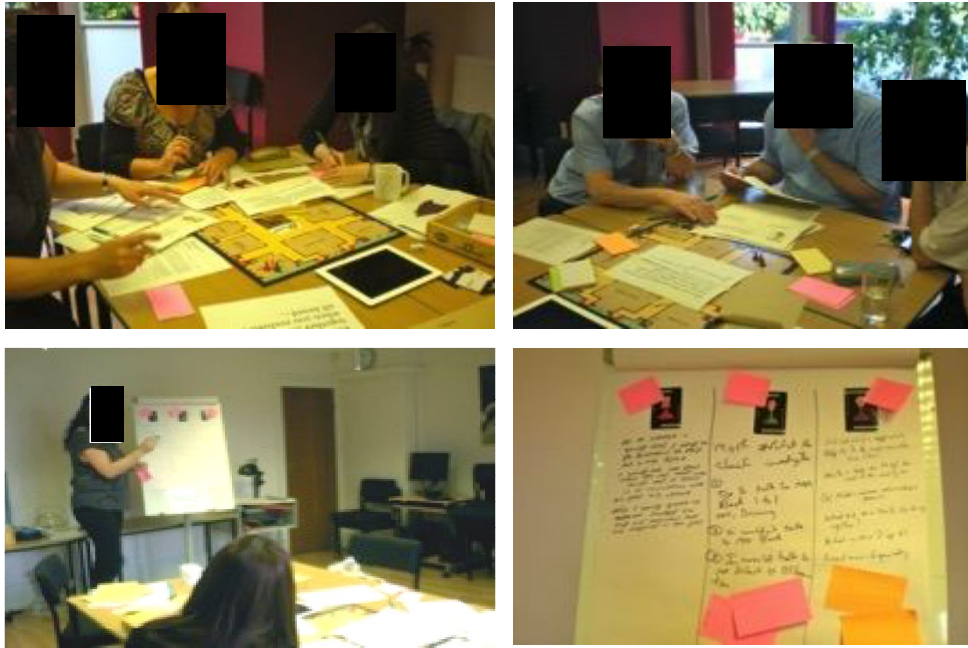


Figure 4-17: Paper-based prototype (Hazel Court v.1.0) playtest photos, showing first level (photos up) and third level (photos bottom) of the game dynamics. The iPad that is in the photos was present only for back-up audio recording.

The collected qualitative data (i.e. audio files and written notes) were then analysed with regards to the playtest's objectives. I listened to the audio files, and then extracted and transcribed relevant quotes only, and did the same with my written notes, using stated objectives as criteria. I combined analysis of both what participants did (i.e. a behavioural metric) from my written notes, and what participants reported in the debrief interviews (i.e. an attitudinal metric) from the audio quotes [140].

4.3.4.3 *Results*

All planned playtesting sessions took place, with the planned number of participants per group. Three of the four groups of

players played all of the dynamics levels of the game (one group did not engage in all implemented creativity techniques, only in brainstorming), and all four groups generated new ideas from the process of play.

The key implications from these early-stage observations are the following:

- The successful use of the board game reinforced the importance of **physical elements** of the game. Indeed, the tabletop nature of the game, with the game board, and paper elements provided horizontally on the table seemed to enhance the user experience and encouraged collaboration and **trust**, which was deduced from a continuous verbal communication between the players, spontaneously throughout all the playtests (e.g. *“I did a lot of trainings... when you’re listening to a presentation you can just zoom out and be invisible, this is good because you can’t be invisible, you literally have to stand up, have to get involved, have to think... I get bored if I’m just sitting there, I start yawning, here we were together”*);
- Some of the players were unclear about the **purpose of the second part of the game** – the mini-task of searching for objects in the physical space – indicating a need to link both the objects and the searching for them more closely to the storyline of the game (e.g. *“I wasn’t sure about that part of the game, that kind of put me off, but I really liked getting up on my feet and going into action, felt a bit dangerous and exciting... (others join in to agree) ...maybe you could relate those clues more to Mr and Mrs Black,*

instead of weapons something like that taxi driver's hat we had, or wedding rings, picture of their son..." - P1S1);

- The need for greater **facilitation of the creative process** was also indicated. The combinational creativity task in the third part of the game was not effective without clearer, more integrated facilitation of the technique and explicit creativity prompts - participants often tried to pose questions to the researcher and seemed to be confused at times, resulting in a decrease of flow;
- Participants finished the training with an implication of **feeling curious** about what would happen if they have chosen a different path in the dynamics (e.g. *"What would happen if we went to the Dining room there?"*, asked one participant in the debrief, and then the group expressed they would like to play again; *"I liked how you can go into different rooms and then choose yourself where you want to go, very mysterious, familiar like in Cluedo but still so different..." - P2S1);*
- Participants seemed to **overall positively engage with the premise** as intended (e.g. *"It was amazingly engaging, some of this stuff is really responding right to the challenges we face" - P3S1; "I really liked Prof Plum, he reminds me of a bloke I'm working with" - P3S2; "I liked having all these different people, we picked roles based on our personalities I guess, but it was really good having family, friends, carers all together... it would be good to make carers take other roles, of residents or friends, to practice their empathy, change the sides" - P4S4; "I really like that you kept saying there are no right or wrong answers" - P1S2);*

- In terms of the challenge level, the **ambiguity of clues** seemed to be well accepted, but the representation seemed to require adjusting (e.g. *“It all depends on what you see in the clue, somebody else would see something else maybe, depending on the experience maybe, but it is up to you what you make of it... but we agreed on our final solution”* - P3S3; *“It would be good if they would somehow really be hidden in the rooms on the board”* - P1S4).

4.3.4.4 *Conclusions*

Drawing conclusions from the early-stage observations made in the study, the four main design recommendations *R2.1-R2.4* for the next phase of the CSG development were the following:

R2.1: Introduce digital elements in a way that preserves the positive aspects of physical interaction (e.g. tactile, present, integrated in the physical game space, more easily shared and discussed in real-time), because it seems to be an important for the CGBL aesthetics of *Trust* and *Joy*;

R2.2: Refine the second level of the dynamics by changing the nature of the clues in the treasure hunt, making them semantically closer to the domain;

R2.3: Refine the third level of the dynamics by introducing more facilitation of the techniques supporting convergent thinking;

R2.4: Refine clues representation in a way that makes them more integrated and accessible.

4.3.4.5 Threats to validity

The recognised threats to validity of the playtest were the following:

- The sample in the study was too small to draw any general conclusions, but it was still effective for this design phase. I had limited access to participants and therefore could not obtain a bigger and more randomized sample in terms of demographics. However, for the physical prototyping phase of game's formative evaluation, it is considered a good practice to run smaller qualitative studies with which to generate timely recommendations for the next iteration [62], and therefore this set-up served its purpose;
- A physical prototype is not an accurate representation of the game user experience, which can influence the outcome of the game. However, such an approach is valuable because the outcome is not measured at the early stages of design, and the focus is on the mechanics still being defined. A physical prototype communicates the vision of the game more vividly than a mock-up or design specification document;
- Whilst this study's objective was adequately addressed using attitudinal metric of feedback assessment, the lack of video material prevented a more detailed analysis using a behavioural metric. In this study, I therefore relied only on

participants' self-reports, whilst more could be learned from analysing their interactions with the game in more detail. Therefore, in order to obtain a more complete insight into CSG user experience in the next study, video data was also collected and analysed.

4.4 Hazel Court v2.0

Drawing on the lessons learned from the physical prototyping, I designed and implemented a new version of the *Hazel Court* CSG. This new version adapted the concept and contents that had been playtested with the physical prototype, to the game dynamics that combined digital and physical resources and design elements (see *R1.5* in Section 4.2.5, and *R2.1* in Section 4.3.4.4). The re-design also sought to improve the appropriateness of the integrated creativity support (see *R2.2* and *R2.3* in Section 4.3.4.4) and the overall CSG user experience.

This section is reported in 3 parts: i) the re-design actions in terms of game's resources, mechanics and dynamics; ii) the internal usability testing of the prototype; iii) the playtesting of the improved digital prototype in the field and resulting recommendations for the next phase of the iterative playcentric design process.

4.4.1 Game re-design and digital prototyping

The *Hazel Court v2.0* CSG implemented the same concept and contents as were playtested in the paper-based prototype (see

Sections 4.3.1), but introduced several significant changes to its resources, mechanics and dynamics. Each addition is described in turn.

4.4.1.1 Resources

The most distinctive new feature that *Hazel Court v2.0* introduced was a digital resource of the game, developed by Imaginary s.r.l., with whom I collaborated on creating the mock-up (see Section 4.2.2), on the basis of my design and contents I provided. This digital resource was a web app (Figure 4-18), optimized for use on an internet-enabled iPad 2 and implemented to be equivalent to the board in the game, for information exploration and gathering in the divergent thinking dynamics' phases (see Section 4.3.1.4). The assumption behind this design choice was that the mash-up between the digital support and the traditional board game environment would provide a more immersive environment for players (see Section 2.1.2.3), and help create a climate within the training session that would more actively stimulate their creative thinking (see Section 2.2.1.2). Another anticipated benefit was that the clue base and branching could be more easily expanded in the digital component, compared with the cards in the physical prototype. The original *Cluedo* board, character figures and cards were still used as a map illustration and tokens to support the storyline, but had no other influence on the game dynamics.

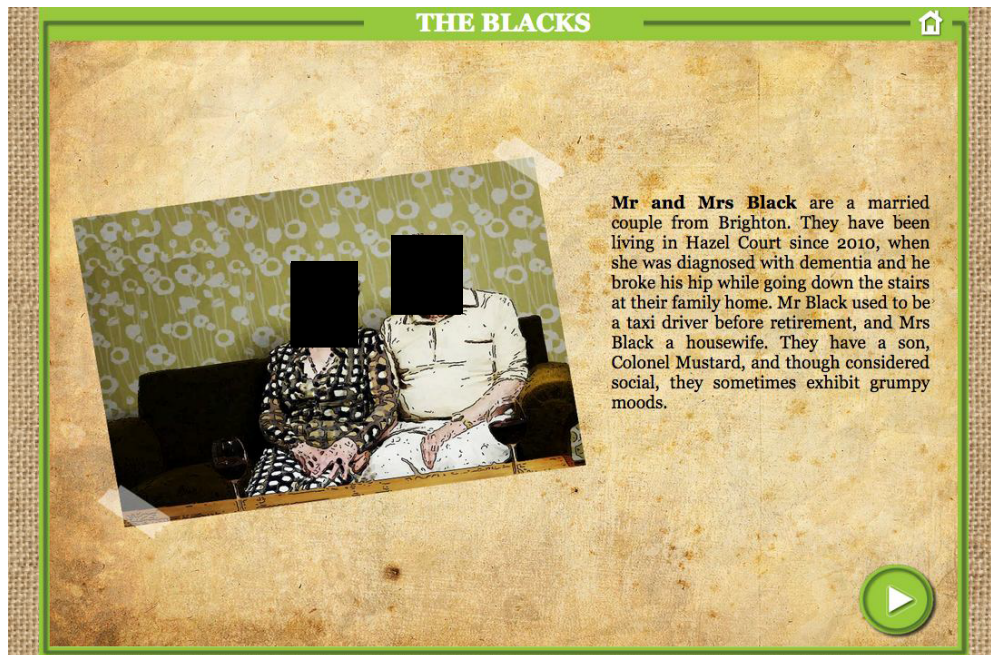


Figure 4-18a: Some screenshots from *Hazel Court v2.0* web app, showing the support to the various stages of clues exploration, discovery and manipulation, from top to bottom: meeting the Blacks; meeting the other characters.



Figure 4-18b: Some screenshots from *Hazel Court v2.0* web app, showing the support to the various stages of clues exploration, discovery and manipulation, from top to bottom: kick-off in the Hall of Hazel Court; clue whiteboard.

The digital component of *Hazel Court v2.0* ran in a web browser on any platform with an Internet connection, optimised for Google

Chrome 17, Mozilla Firefox 10, Internet Explorer 9 or later versions. Because the CSG is played in cooperative play mode (see Section 4.3.1.1), only one device per playtest was needed in this version, independent of the number of players. The independence from care home's own systems was also an advantage, as most of the care homes are poorly IT equipped. The app was developed in HTML5 and further optimized for the iPad 2 with a WiFi connection.

Furthermore, the app introduced support to character profiles and statements, as in the physical prototype but via a different medium (see Section 4.3.1.3) - in audio format. Casting for characters' voices was done amongst my colleagues at City University London. The reason behind this design choice was that by mixing the media input format, as proposed in the mock-up (see Section 4.2.2.3), the game design would not only add to its resource variety, but trigger more connections with the real-world work experiences amongst care staff.

As in *Hazel Court v1.0*, the physical resources of the game included materials with which to record generated ideas such as a flipchart, post-it notes, markers and pens. One additional resource was a pair of dice to decide on to which room to go next when consensus among players could not be reached (i.e. the one who gets the highest number, wins the right of choice). The assumption behind this design choice was that it could further support the working of the mechanics of *Variable challenge*.

Another new feature was the introduction of physical clues that were semantically closer to the domain, yet kept a certain level of

ambiguity to support divergent thinking. There were six physical clues that supported the storyline hidden in the room in which training was held – and to be found during the treasure hunt (i.e. incubation) phase of the game dynamics, and later used for generating ideas: a postcard from the seaside, a doll, a car toy, computer headphones, a shawl and a music record (Figure 4-19). This design choice directly addressed one recommendation that resulted from the previous playtest (see *R2.2* in Section 4.3.5), to make the objects in the treasure hunt semantically closer to the domain.



Figure 4-19: Photo from the *Hazel Court v2.0* playtest in the field, showing players using the digital clues whiteboard in the web app on iPad 2, together with the physical resources and clues.

4.4.1.2 *Mechanics*

The instantiation of the CGBL mechanics in *Hazel Court v2.0* corresponded to the mechanics instantiation in the physical

prototype (see Section 4.3.2). However, some important extensions were introduced in order to adapt to the changes in the game resources, and relevant design recommendations from the playtest.

This version of *Hazel Court* introduced a person in the role of facilitator, a **game-master**. The game-master corresponds to the concept of tutor in the game mock-up (see Section 4.2.4.2), or the trainer in the professional training setting, and such facilitation was introduced to enhance players' performance in terms of creative learning outcomes (Figure 4-20). In playtesting of this version of the game prototype, the role was performed by myself. Previous playtests revealed the need for the creativity techniques in the third level of the game dynamics, which were supported by the mechanics of *Resource management*, *Customisation* and *Feedback*, to be facilitated in order to be more effective in terms of usability (see *R3* in Section 4.3.4.4). The hypothesis was that the players would benefit from being supported during these creative process stages, as in a traditional creativity workshop setting [89], by having an agent providing additional instructions, prompting the discussion and adapting the dynamics based on players' input.



Figure 4-20: Photo from the *Hazel Court v2.0* playtest in the field, showing the game-master facilitating the third level of dynamics in the CSG session with 4 care staff players.

The digital component introduced **hiding the clues about Mr and Mrs Black within the graphics of each of the rooms** of *Hazel Court* (Figure 4-21), whilst character statements were made accessible in audio format and the physical clues were hidden in the actual room where the CSG took place. All of these clues were summarised in the **clue whiteboard** that allowed clues to be re-examined (see Figure 4-18). This feature encouraged players to engage in *Resource management*, *Customisation* and *Feedback*. If players clicked on the clues on the whiteboard, they zoomed in to receive more information. For example, if they clicked on an image of a character that they encountered, they could zoom into a transcript of what the character said in the game in audio. Using a tablet mobile device to explore the web app's contents was intended to enable easy access to clues that players can control, whilst preserving the mode of cooperative play, which aimed to engage players with the *Feedback* mechanic. A recommendation from the physical prototype playtest was that clues should be

made more integrated and accessible (R2.4 in Section 4.3.4.4), consequently suggesting modification of the instantiation of *Hazel Court v2.0* mechanics of *Collecting*.



Figure 4-21: Screenshot from *Hazel Court v2.0* web app, with a hidden clue (in this case, a care plan) in the Library of Hazel Court. Can you spot it?

There is also Colonel Mustard, with something to say in audio format.

After you have noted all that, you can go to the Conservatory, to find out more about how to cheer up Mr Black, or to the Billiard Room, to find out more about how to cheer up Mrs Black. Where would you go?

Moreover, the clue whiteboard (Figure 4-18) offered additional text prompts when applying the creativity techniques (see Section 4.3.2), which were identical in content to the physical prototype, but now via a different medium and additionally facilitated by the game-master. In order of appearance, these text prompts were:

- *After your little investigation, do you feel the rumours are true, false or you are not sure either way? Why? Take a few minutes, as a group, to browse all the information you collected on your way, and organise them in at least two meaningful categories. Meaningful is whatever you consider it to be. (Re-examining & organising information)*

- *Pick a clue from the different categories you made, and by combining these clues together, try to inspire yourself to brainstorm ideas for a new way to engage with Mr and Mrs Black. Use post-its to capture your thoughts. Do that individually for a few minutes, and then take turns to share.* (Combination & brainstorming)
- *Do you sometimes need to act as a detective in your everyday work in care? Could you remember a situation like that? Share your reflections.* (Transfer from excursion)

These prompts supported the players to engage with the *Resource management, Customisation* and *Feedback* mechanics.

4.4.1.3 Dynamics

Description of activity	The CGBL dynamics	The CGBL mechanics
Introduction	Divergent thinking using digital clues	Resource Management, Customisation, Collecting, Variable Challenge
Meet the Blacks		
Meet the other characters		
Kick-off in the Hall		
Exploring Room 1		
Exploring Room 2		
Treasure hunt	Divergent thinking using physical clues	Resource Management, Customisation, Collecting, Variable Challenge
Re-examining and organising the clues on the whiteboard	Convergent thinking	Resource Management, Customisation, Feedback
Combination		
Brainstorming		
Transfer from excursion		

Figure 4-22: The *Hazel Court v2.0* dynamics description.

As with the *Hazel Court v1.0* (see Section 4.3.3), the digital prototype intended to support the creative process stages of

divergent thinking and convergent thinking. The *Hazel Court v2.0* instantiation of the CGBL dynamics inherited and adapted the dynamics structure from the physical prototype, as defined in Figure 4-22 in the context of the anticipated events during the game play, and the implemented game mechanics involved in those events.

4.4.2 Usability testing

In month M15 of the project, before the digital prototype playtesting in the field, a focus group session was internally organized in a lab setting at City University London with three non-carer HCI professionals to determine general usability issues with *Hazel Court v2.0*, and consequently to be able to communicate the related re-design recommendations to developers. These participants were asked to explore all branches of the game, to play it from the beginning to the end while thinking aloud and making pauses to comment during the process. Duration of the session was 1 hour 18 minutes. Data was collected in the form of written observations and a video recording, with participants' consent. Design recommendations were coded using an adapted form of Nielsen's method for heuristic evaluation of user interfaces [134].

All issues marked with the highest severity rating were given priority and addressed, which resulted in 16 out of the total of 20 recommendations being acted upon. The findings were reported back to developers, and corrected in the scope of available resources (both in terms of cost and time, as the playtesting was

scheduled only three weeks after the focus group). Most of the identified issues with the highest severity level were related to *User interaction*, *Visibility of the system status*, and *Match between the system and the real world*, while the most issues with the lowest severity level were related to *Graphic design* difficulties. The participants reached a consensus on the observed issues, which were reported in order of issue severity, summarised in turn (see *Coding scheme*, and *Results* table at the end of this section).

Coding scheme

Types:

C – *Consistency*: Users should not have to wonder whether different words, situations, or actions mean the same thing. Follow platform conventions;

R – *Recognition rather than recall*: The user should not have to remember information from one part of dialogue to another, cognitive overload cause;

I – *Information*: Relates to what information is presented by the system at a certain time and how it is presented (e.g. issues with insufficient information);

U – *User interaction*: Issues with (un)expected interaction between players and the system;

S – *System bugs*;

M – *Match between system and the real world*: The system should use words, phrases and concepts familiar to the user, rather than system-oriented terms;

V – *Visibility of the system status*: The system should keep users informed about what is going on, through appropriate feedback within reasonable time;

E – *Ergonomics*: Relates to the physical characteristics of interaction (e.g. with the iPad as a device).

G – *Graphic design* recommendations.

Severity levels:

1 – Prevent completion of task

2 – Create significant delay and frustration

3 – Have minor effect on usability

4 – More subtle and often point to an enhancement that can be added in the future

Results

Nr.	Location	Type	Issue description	Issue implication	Severity level	Recommendation	Corrected
1	Icons in the top menu	M, U	Icon for home is represented by power-on symbol, which is misleading.	Users believed that pressing that button would make them exit the game.	1	Change the icon with a icon standardly representing Home - a house.	X
2	Icons in the top menu	V, U, C	Play and replay icons don't do anything until one meets a character in the rooms. They did not notice that icons turning white meant activation, and therefore did not attempt to play audio.	User is frustrated when nothing happens, nor is it indicated what they could do. When the icons are supposed to be used, they are not noticed by the user, which affects the play significantly.	1	Delete these icons from all the screens where they don't have a function, and make them change colour when they are pressed. Think about moving them from the top menu somewhere in the screen closer to the character. Redundancy - users indicated that one icon would be enough; colour indicates when audio play is active, when the colour returns to 'normal' it could be pressed again for reply. Change the icon with a label 'Play', because it gets confusing with forward icon used in the bottom.	X
3	Meet the characters	M, V, G, U	Icon +, indicating there is more information about characters was not evident to users.	They took a lot of time to discover it and were a bit frustrated and confused.	1	Change the + icon across the application with a pin icon, or a label 'More'.	X
4	How to play; Meet the characters	I	Users did not understand they will each have a role in the game	They played as a team, but lacked personalization. This also prevented them from brainstorming from different perspectives in creativity workshop part.	1	Textual corrections, live facilitation. Think about how to better prompt this step in the future version.	X

5	General	R, U, V	There is no option to go back to the previous step.	Since users did not know they would get an overview of everything that's been collected, they expressed interest in going back and consulting the clues or steps. They showed concern that the game is blocked if somebody by mistake clicks twice, skipping step/information in that case.	1	Make a back option within the game.	X
6	Rooms	V, U	Clue collection – visibility was very low and hardly distinguishable.	Confusion with the goal of the game. It also distracted them from the main objective, which was how to use those clues in creative problem solving.	1	Make the clues more visible by highlighting them in a different way. Presently both the clues and characters and background have a white glow effect, which is confusing.	X
7	General	I	Various	Insufficient information lead to confusion with the process	1	Textual corrections and physical facilitation improvements to be implemented.	X
8	Icons in the top menu	V, U	Chat icon does not do anything in this version.	User is frustrated when nothing happens, nor it is indicated what it could do.	2	Delete this icon form the current version.	X
9	Debrief	S	Since there was no back option within the game, users used the back button of the browser, which caused a disruption in the Debrief screen (e.g. two Mrs Whites, no digital clues represented).	No correct debrief overview.	2	Resolve the background code, so that it handles this action with expected output.	
10	General	V	Safari does not support full screen.	Full screen was not available for play, scrolling needed.	2	Optimize the display of the app. Make it a full screen web app.	X
11	Debrief	S	Home icon does not do anything.	Confusion.	2	Make this icon go to the home screen.	X
12	Ballroom	G	The lady behind Prof Plum is also wearing a purple t-shirt.	Since the characters are differentiating by the colour of their clothes, it is confusing.	2	Change the colour of the t-shirt of the woman.	X

13	Lounge	G	The lady behind Mrs White is also wearing a white shirt.	Since the characters are differentiated by the colour of their clothes, it is confusing.	2	Change the colour of the t-shirt of the woman.	X
14	Conservatory	G	Mrs Peacock's lip is purple.	Looks like she was beaten.	2	Graphically correct the lip.	X
15	How to play; Meet Mr and Mrs Black	G	Low contrast between background and text.	Poor readability.	3	Increase contrast by lightening the background/dark spots on it.	X
16	General	G, C	Cartooning the characters and the background. This was one of the strongest concerns displayed by users.	Black lines make the characters look deformed. The clean lines of the outer interface in dialogues are in high contrast with the characters and background, and there is no uniform feeling to the interface. Clues, interface, characters, background seem inconsistent in graphic style.	3	Make the characters either completely animated or use actual photographs (remove black lines). Give a more uniform feeling to the application, by having a uniform colour scheme, and design style which would be either fully clear-edged and life-like, or animated and soft-edged. Make clues, background, characters, interface consistent in style.	
17	Rooms	C, G, U	Buttons for the choice of next step look pressed.	Users had doubts whether something would actually happen if they press it.	3	Change the graphics of the buttons so that the outer edges are not so dark, make it pop out as an actual button is expected to.	
18	Debrief	M	Users attempted to inspect the clues in the whiteboard in more detail, small icons.	Mild frustration.	3	Allow the zoom-in option.	X
19	How to Play; Meet the Characters; Meet Mr and Mrs Black	G, U	The italics font used was on the border of being legible.	Older participants would have trouble reading this information. As one participant noted, if it were not standard Cluedo names, it would be much harder.	4	Consider using a different font for these labels.	X
20	Rooms	R	Clue collection – users expected a sort of a “bag” in the bottom right corner where they could drag in and store what they have collected, and always have an overview.	They forgot what they had collected on the way.	4	This could be resolved physically or by integrating this option in the future version.	

4.4.3 Playtesting

The physical prototype helped to define and test the CGBL mechanics instantiation in *Hazel Court* CSG. The digital prototype extended that design work into a digitally supported form, and implemented the recommendations from the previous playtest. Translating the game into another medium allowed a new iteration of playtesting of the game concept and refined the mechanics that came one step closer to their intended format, as targeted by *OBJ2* of the project that the work reported in this chapter addresses. The following sections report on the motivation, method, results and conclusions from the *Hazel Court v2.0* playtesting in the field.

4.4.3.1 Motivation

According to [62], there are four types of digital game prototyping, depending on the questions designer is aiming to address: prototyping mechanics (as defined by the CGBL framework, Section 3.3.5), prototyping aesthetics (as defined by the CGBL framework, Section 3.3.3), prototyping kinesthetics (i.e. the “feel” of the physical components of the game, how the controls feel, how responsive is the interface, etc.), prototyping technology. Playtesting of *Hazel Court v2.0* was focused on prototyping the mechanics and resources (see Sections 4.4.1.1 and 4.4.1.2), so the objectives of the study were to:

- *OBJ1*: Investigate the dynamics of *Hazel Court v2.0* in the context of the CGBL framework;

- *OBJ2*: Investigate the CSG user experience *Hazel Court v2.0* in the context of the CGBL framework.

4.4.3.2 *Method*

Playtesting took place in month M16 of the project, in the one *Life Opportunities Trust* care home in Kings Langley, UK, where new participants volunteered after hearing their colleagues' positive impressions from playing *Hazel Court v1.0*. There were four playtesting sessions: two groups with three participants (S1, S2), one group with two participants (S3), and one group with four participants (S4). Initially the aim was to playtest the game with three carers in each session, but unforeseen circumstances at the site required the last minute change. A colleague researcher, who took some open-ended written notes about the sessions' climate and proceedings, observed the sessions, and I ran them in the role of the game-master.

The playtesting session was planned as follows:

- *5 minutes* – introduction, explanatory statement presentation and informed consent acquisition (Appendices B-2 & B-3), and warm-up;
- *30-40 minutes* – game play as described in Section 4.4.1.3;
- *15 minutes* – open-ended debrief interview.

The collected data were:

- photos (e.g. Figure 4-23);

- video recordings from two angles - one of the table where the game components were, the other focusing on participants' faces;
- the written notes made by a colleague researcher who observed all the sessions.



Figure 4-23: Photo from *Hazel Court v2.0 playtest*, showing the players interacting with the web app. At the moment when the photo was taken, players were in the Lounge of Hazel Court, listening to the audio statement of Mrs White.

Attitudinal metric: Debrief questions in the interview, after the warm-up, focused on different dimensions of CSG user experience (i.e. addressing *OBJ2*) as defined by the CGBL framework (see Section 3.2). Since the debrief interview was open-ended, its form adapted to each group, and in effect not all of the questions were addressed in each interview, either due to the time slot ending, the issues being covered by another question, or the group not having any feedback to report. The answers were analysed in the context of the recommendations for the next phase of re-design of game mechanics and resources (see Section 3.3.5). The debrief checklist was:

Introduction:

- ALUO (Advantages & Limitations);

Dimensions debrief:

- How was it for you? How did you feel in the gameplay? How challenging was it? (CHALLENGE);
- Is there something in the game that personally appealed to you? (FREEDOM);
- Did you feel in control of what was happening in the game? (FREEDOM);
- Did you feel time pressure? (IDEA-TIME);
- How did you feel about sharing your ideas with the group? How was the feedback? How open were people in the group? (IDEA-SUPPORT, TRUST & SAFETY);
- How did you feel about making choices? (FREEDOM);
- Was it fun? (HUMOUR & PLAYFULNESS).

Behavioural metric: The game dynamics were analysed using the session timelines that I created using the collected video data. Timelines were organised in terms of game events that were triangulated with screenshots from the videos to illustrate the events, and researcher's notes to provide additional explanation of the events. I coded the events in terms of the dynamics levels and the activated mechanics (i.e. addressing *OBJ1*) and compared with the CSG design envisioned by the dynamics analysis (see Section 4.4.1.3).

The coding scheme was agreed using Jaccard's inter-rater reliability test [108] $((\text{Coder 1 code(s)} \cap \text{Coder 2 code(s)}) / (\text{Coder 1 code(s)} \cup \text{Coder 2 code(s)}))$ on 50% of the samples (i.e. two timeline samples), reaching 0.67 agreement (agreed on 47 out of 70 applied codes in total), which is considered satisfactory [108]. Most of the disagreement between coders was about the application of the *Feedback* code from mechanics set, and the

Acquire knowledge and the *Find & formulate problem* codes from dynamics set. For the coding scheme, please refer to Tables 4-1 and 4-2.

4.4.3.3 *Results*

This section reports the results provided by the four groups during the playtesting. Sessions 1 & 2 had three participants each; Session 3 had two participants and Session 4 had four participants. Each group was at least partially successful in engaging with the game dynamics, and reflected on the game play experience in the debrief. I analysed this feedback, and data collected about the game events that the feedback addressed, using the components of the CGBL framework.

The timelines of the playtesting sessions (Appendix C-3) were described and analysed according to different elements reported in the following summaries. The timings, descriptions of activities and related images from the different video cameras are reported throughout, to provide a narrative description of each game event. Each segment was then analysed in order to determine: (i) the activated CGBL mechanics (see Table 4-1), and; (ii) a mapping to the most relevant part of the CGBL dynamics (see Table 4-2). The timelines are followed by debrief feedback analysis. The debrief often included valuable reflective sharing of experiences between participants, suggesting positive creative learning outcomes. Timelines also provide, at the beginning, more details about the participants. An example of a timeline (Session 1) is provided at the end of this subsection.

Several of the participants were confused and unsure of what was going on for the first 15 or so minutes, indicating that more explanation and set-up was required up front. Also, encouraging more group discussion throughout the session might have enabled detection of those who are confused by the game, so that they can be given further information either by the group or by the facilitator. Overall, the need was recognised for more context setting.

In Session 1, the general climate in the room felt relaxed and positive. However, there was very little chatting to begin with. Everyone read the instructions quietly, and then discussed very briefly when it was time to make decisions, rather than engaging in group collaboration. The search for clues was the most engaging part of the session, and the participants did seem to liven up and get into the game a bit more at that stage. The playfulness came into it then, and participants collaborated more afterwards. *P3S1* was quiet for most of the session and only began to contribute towards the end of the session when there was group discussion. As she did not indicate any disliking or barriers to using the game, it's difficult to say why. In Session 2, the climate in the room at the end of the session was much better than at the start, and the participants seemed to enjoy the discussion element of the session, when they reflected on their practice and exchanged experiences. Similarly, in Session 3, participants engaged in a reflective conversation in debrief, which had clear elements of knowledge transfer. In Session 4, the group seemed very positive about the game, but stated that it might not be appropriate for their experience level, which was advanced. They

had some interesting ideas of how to add engagement to the game.

Code set	Code	Label	Meaningful behaviour	Example
CGBL Mechanics <i>- Recalling processes implemented in design</i> <i>Adaptation from [200]</i>	Feedback	F	Mutual support amongst players that helps to improve performance; exchange of thoughts, ideas and opinions.	<i>Player 1 said to Player 2 she really likes his idea.</i>
	Collecting	Co	Saving, marking, tagging or displaying of the resources.	<i>Players found all the hidden artefacts on the location.</i>
	Customisation	Cu	Expression of one's identity, personalisation of the game world through decision-making and role-playing; creating resources.	<i>Player 1 explained his understanding of the task and proposed a strategy for the next move.</i>
	Resource management	RM	Controlling, planning or deploying the resources in order to achieve the game's goals.	<i>Players discuss associations with resource obtained in the game, or relate it to other resources.</i>
	Variable challenge	VC	The challenges are adjusted to match the ability of the players, to avoid boredom or frustration.	<i>Players seem shy and said they never brainstormed before, so the facilitator gives more explanation of the creativity technique.</i>

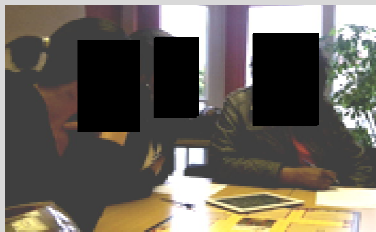
Table 4-1: Coding scheme applied on the timeline data, based on the CGBL mechanics from the CGBL framework.

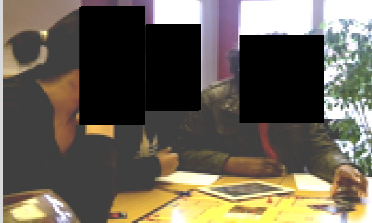
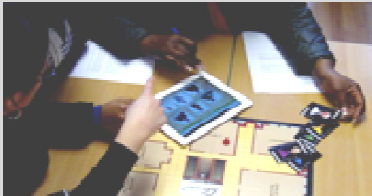
Code set	Code	Label	Meaningful behaviour	Example
CGBL Dynamics - Emerging processes during a CGBL play Adaptation from [162]	Find and formulate the problem	1	Identify and formulate the game goal in such a way that it will be more likely to lead to a creative solution.	<i>Players explore the game's objective.</i>
	Acquire knowledge relevant to the problem	2	Initial information input gathering - directly domain-specific.	<i>Mrs X has dementia.</i>
	Gather a broad range of potentially related information	3	Prompted awareness to unexpected and apparently unrelated information in the environment.	<i>Mrs X likes cats.</i>
	Take time off for incubation	4	The information gathered in phases 2 & 3 is left to one's unconscious mind to be processed and associated in surprising ways, whilst not actively problem solving.	<i>Players make a 10min break for tea.</i>
	Generate a large variety of ideas	5	Conscious attention to the problem in order to attempt generating possible solutions.	<i>Brainstorming using post-its.</i>
	Combine ideas in unexpected ways	6	Combining existing mental concepts or ideas into new concepts.	<i>Players combined the ideas from category X into one scenario.</i>
	Select the best ideas, applying the relevant criteria	7	Selecting which idea from the generated set to pursue further, that promises the most effective solution, based on some chosen criteria.	<i>After some discussion, players decided to develop further pile 2, because...</i>
	Externalise the idea using materials and representations	8	Ideas emerge, develop and transform when expressed to the world.	<i>They made a sketch of their solution on paper and discussed it.</i>

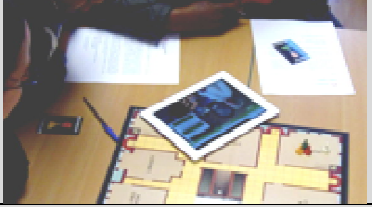
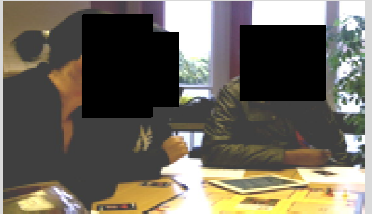
Table 4-2: Coding scheme applied on the timeline data, based on the CGBL dynamics from the CGBL framework.

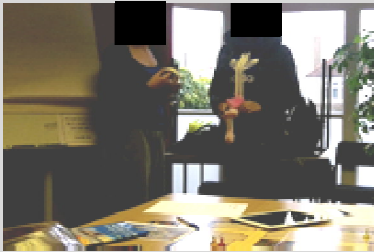
Session 1 (16/01/2013)

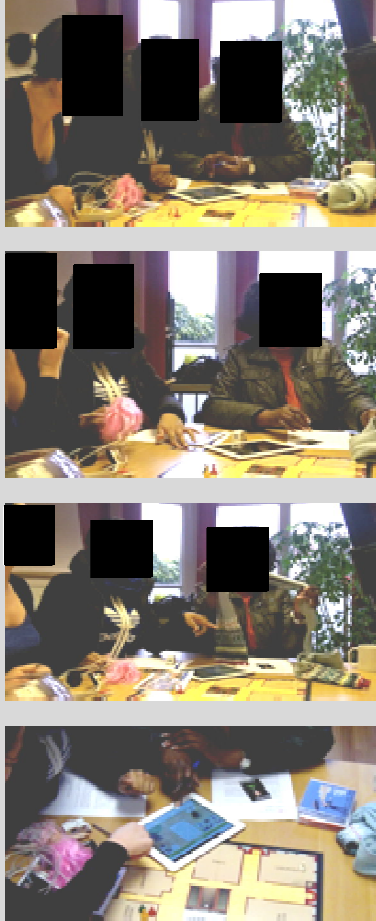
Participants: 3 female trained carers, from left to right P1, P2, P3, and facilitator F;
 Age: Two younger carers (P1, P2) and one slightly older (P3);
 Work experience: P1 and P3 are experienced, whilst P2 just started working recently;
 Total time: 41:50 minutes; duration of the playtest: 28:48 minutes;
 Source file(s): JanS1_Camera1.mp4, JanS1_Camera2.mov

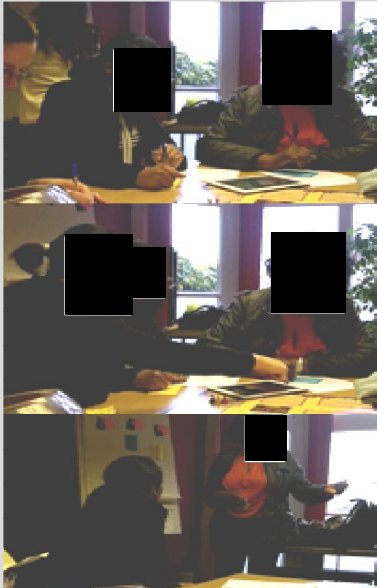
Time	Description of activity	Image	Mechanics (CGBL)	Dynamics (CGBL)	Notes
00:00	Participants sit around the table and look at the starting page of Hazel Court v1 web app on the iPad, which is placed in front of P2. F is on the other side of the room, watching but not assisting. P2: "That's Play?" and P1 then presses the button, and they are transferred to the Introduction screen. P3 takes about half a minute longer to read the introduction on how to play the game. Whilst reading, everyone is silent. P2 intuitively understands the 'Next' button. On the second page of the introduction, they try to play the example audio button, and seem a bit confused when nothing happens. Everybody is still silent, communicating only briefly to agree on when everyone is ready to proceed. P3 again takes a bit longer to process the input.		RM	1	The general climate in the room felt relaxed and positive. However, there was very little chatting to begin with. Everyone read the instructions quietly, and then discussed very briefly when it was time to make decisions, rather than engaging in group collaboration. Might want to encourage group to speak aloud – say what they are doing and thinking when using the game – good for getting the group to share. Also, better if someone reads out the text on the screen as it's hard for everyone to read. Might be worth highlighting that this is about team work and making decisions as a team – encourage discussion. Might be good to make the font bigger and clearer, for easier readability, especially for older players.

1:40	P2 presses the button again, taking them to Meet the Blacks page; the atmosphere in the room lightens up. P1 smiles, and P2 looks more relaxed, P3 puts her chair closer to the others, leaning more forward. P3 again takes about 20sec longer than others to read; P2 takes them to the next page.		RM, Co	2	/
03:00	Meet the characters page. Facilitator says each of them is going to become one of the characters, lays out the character cards and invites players to pick a role. P2 asks whether to read the cards first and then pick, or the other way around, F says “as you wish”, they choose to read first. Players seem a bit intrigued and keen to start exploring the set; P1 says “I wanna see what she says” and picks Miss Scarlet on the screen. She seems happy with what she read, and picks Miss Scarlet card, the facilitator gives her the red pawn. Some short laughter. P3 then selects Mrs Blue on the screen. Some troubleshooting with closing the window of the card by pressing the cross and the opening the next card, but they get there after a couple of tries. Eventually, P3 picks Mr Green and P2 picks Col. Mustard, and are given corresponding pawns. Some brief communication about associations with character profiles. P3 re-reads her characters description before proceeding to the next page.		RM, Co, Cu	2	Might make icons in the app a bit bigger for easier selection on the mobile device. Might want to encourage more discussion about the characters through facilitation, to increase immersion.

05:00	They are on the Hall page. F puts their pawns on the Hall on the board. Everyone goes back to being silent again and focus on reading. After about half a minute, facilitator clarifies briefly what is going to happen next (“now you’re going to take off, in the rooms you will be looking for clues and try to remember them, and you investigate as a team”). P1: “shall we go see Mrs White, she knows all the gossip?” and tries to press the Lounge button but there are problems with loading, third time it works. F moves their pawns from the Hall to the Lounge on the board. P2: “shall we use the board now or move in here?” (i.e. iPad), P1: “use this” (i.e. pointing on iPad), F is indifferent.		RM, Co, Cu	3	Unclear use of the board might need to be resolved, either dropped or rethought.
06:55	Players are in the Lounge and they spot the audio play function right away, P1: “let’s hear what she has to say”, P2 raises the volume on the device and moves the device closer to P3. P1 then immediately says they should go to hear what Mr Green has to say, others approve.		RM, Co, Cu	3	Make sure volume on device is on the max. No discussion of the visual clue hidden in the Lounge, players haven’t noticed it, nor looked for it. How to make clues more obvious? The group misses the clues. Are they too obvious?
07:58	They find Mr Green in the Billiard room. After they heard what Mr Green has to say, F: “Have you noticed some clues in the rooms perhaps?”, P2: “There was something but I wasn’t sure what it was”, P1: “Can we come back?” F: “Don’t worry, it will come back later”. P1 says she remembers one room had a laptop. They very quickly pass to the next page.		RM, Co, Cu, F	3	Players didn’t interact with the pawns on the board, to move them to the next room. No ‘Back’ option in the app during room exploration.

08:57	Treasure hunt introduction in the Ballroom, taking them outside Hazel Court. This time, P2, more relaxed than before, reads half-loud, so it is not completely silent in the room. P2 and P3, ask “in this room?” They stand up and start the search and bring to the table items that were not implemented by design (e.g. magazine, 10:29). They communicate across the room (e.g. P3 asks: “is this your bag?”). They can’t find the last two clues, so F poses them hot-cold challenge. F discards emerging clues.	 	RM, Co, VC	3	Emerging clues utilization? And encourage, in order to increase degree of freedom? The search for clues was the most engaging part of the session, and the participants did seem to liven up and get into the game a bit more at that stage. The playfulness came into it then.
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12:23	Participants re-examined all the clues using the “whiteboard” page. They seem a bit confused. F says: “What you could now do perhaps is look at what you have got from the clues, and what they may mean to you, and then sort them into categories that might be meaningful to you”. P2 asks if they should do it in their role, F confirms. Players discuss each of the physical clues first amongst themselves in the context of the Blacks (from 14:32 onwards), and then they examine the whiteboard contents. They quickly converge towards the possible solutions, rather than discussing meanings of clues. Participants disregard the Combination prompt, F doesn’t force it. At some point F says: “if you want to record your ideas, you can use post-its and pens, if you want to put anything on paper”. However, players ignore the suggestion and don’t reach for them, even though they are on the table. P1 then says “is this on?” and shifts the focus back on to the device (16:00). P2 recognises the clues (“yes, that’s what I saw!”) from the rooms. They discuss the meaning of digital clues and P1 starts writing down ideas. Eventually the others start using post-its too. Music, dancing, scarf capture their attention the most.		RM, F, Cu	5	How to make clearer that they are examining clues from point of view of character? Need some introduction to idea generation - Groundrules + some how to. The group seems unsure of how to do brainstorming, though they are still able to generate one main idea each. They formulate more of a solution, instead of having lots of ideas. Participant 1 wrote down all the connections the group made between the Blacks and the clues. Perhaps it would be good to include this in the workshop process, to let them all write down and display the connections and combinations they have made?
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19:00	Brainstorming, from the point of view of their character, individually at first. F encourages players for fluency and reassures them again that there are no right or wrong answers. P1 using the whiteboard spontaneously for further inspiration. P3 didn't understand they should brainstorm from the point of view of their character, whilst other two players embraced the idea, but only P2 in the end followed up on it. Sharing ideas, using a flipchart (24:13). Even though they were encouraged to go for quantity and were given about 5min, they present only an idea each, and they focus on activities they could engage Mr and Mrs Black in: P1 (holiday by car with the son - taxi driver); P3 (music - dancing, walking in the garden - scarf); P2 (sorts aspects: social - holiday, emotional - child and physical - gardening).		RM, Cu, F	5	More facilitation on brainstorming to enhance fluency. Think about how to better integrate Combination. Role play in brainstorming didn't work out for the players.
28:14	Transfer from excursion not successful, no reflection or discussion occurs when they read the prompt. P2 asks "What do we do now?" Ending 28:48.		/	/	Encourage the transfer with more prompts?

Question	Responses	Notes
ALUO (Advantages & Limitations)	"I like the fact it was more interactive and...how could I say it?...the way it was presented makes it look quite professional...sort of like... did you do this yourself? Did you make this stuff yourself?... It looks professional. (P2); "It was a refresher... you tend to forget, and when you sit here and discuss it, we refresh our memory, and we go on doing what we discussed here" (P3); "Another thing I liked was in the end, when it said now you could go back to the Blacks in your own care home, because I wasn't thinking about real life, I was thinking about what I wrote down, about their well-being, based on clues that we found" (P2); "Like personal belongings in their room... I found this interesting" (P3); "When they move in they might tell you they like this, this and this, but later they might be further back and you have to start again, and have a look" (P1); "I thought we would use the board a bit more" (P2); "It was short" (P3); "...yeah, I'd be happy to go for a few more rounds!" (P1)	P3 was quiet for most of the session and only began to contribute towards the end of the session when there was group discussion etc. As she did not indicate any disliking or barriers to using the game, it's difficult to say why.
How was it for you? How did you feel in the gameplay? How challenging was it? (CHALLENGE)	34:02 - "I was quite intrigued, I wanted to know more" (P2); "...they were telling me what I wanted to know" (P1); "...I wondered how it would all end" (P2). "...and how did you feel when it ended?" (F); "I wasn't sure was it for real life or not, and then in the end I realised, ok, now I know what it was all about" (P2)	
Is there something in the game that personally appealed to you? (FREEDOM);	"I was comfortable being Scarlet" (P2); "...I was, but I don't think roles contributed much, I couldn't understand where we were going, and then I understood where we were going... Mr Green, I didn't understand his role very much, couldn't remember, but I understood later when with others, Mr and Mrs Black and their son" (P3)	Question seemed not clear to participants. Roles seem unclear
Did you feel in control of what was happening in the game? (FREEDOM)	36:20 - "Not so much... I wanted to go back and see other rooms, see other characters, what they were about and what they mean in connection to Mr and Mrs Black's lives, so that I could connect the clues (P2); P 1 & P3 agree	
Did you feel time pressure? (IDEA-TIME);	"Personally I was relaxed, but if you made it more sort of competition, we would have been more assertive" (P2); "And if the screen was bigger, and the writing spoke, like the characters, it's better than trying to read it, we read it in speed... audio was good and understandable" (P3)	
How did you feel about sharing your ideas with the group? How was the feedback? How open were people in the group? (IDEA-SUPPORT, TRUST & SAFETY);	"It was good because everyone had different explanation, we were talking about the same thing but everyone had different explanation" (P3); "We could read it or hear it in a different way, which is good, mixture of ideas, though I was a bit worried about getting it wrong" (laughs) (P1).	P1 when asked if she felt the climate was good (open & trusting) she claimed that she felt able to share ideas and not be judged, however, she had previously mentioned that she was "worried about being wrong". Indicating that she was feeling performance anxiety on some level.
How did you feel about making choices? (FREEDOM);	/	/
Was it fun? (HUMOUR & PLAYFULNESS)	/	/

Codes Sessions	CGBL Mechanics					CGBL Dynamics							
	Resource management	Collecting	Customisation	Variable challenge	Feedback	1	2	3	4	5	6	7	8
JAN1	9	6	6	1	3	1	2	4	/	2	/	/	/
JAN2	8	4	3	4	2	1	2	3	/	2	/	/	/
JAN3	8	4	5	2	6	1	2	4	/	3	1	/	/
JAN4	10	5	6	3	4	1	2	4	/	5	/	/	/
Total JAN	35	19	20	10	15	4	8	15	/	12	/	/	/
AVG JAN	8.75	4.75	5.00	2.50	3.75	1.00	2.00	3.75	0.00	3.00	0.00	0.00	0.00

Table 4-3: The frequencies of the applied mechanics (Table 4-1) and dynamics codes (Table 4-2) per session (i.e. JANx) and their average values.

The frequencies of the applied mechanics and dynamics codes per session (i.e. JAN x , where x is session number) and their average values are shown in Table 4-3, following the timeline example. The main conclusion was that more game-design support was needed in the convergent thinking level of dynamics, as the participants in all four sessions completed the game at the dynamics level of divergent thinking. The key findings of the timelines analysis (Appendix C-3) are summarised in the form of design recommendations for the prototype improvement, presented in Section 4.4.3.4.

4.4.3.4 *Conclusions*

The following 6 main recommendations *R3.1-R3.6* for the re-design of the game were made at the end of the *Hazel Court v2.0* playtest (for quoted data references, please see the timelines in Appendix C-3):

R3.1: More context setting is needed for the first level of dynamics. Several people from different groups found themselves confused and unsure of what was going on for the first 15 minutes (e.g. see debrief in Sessions 2, 3 & 4). This indicates that more explanation and set-up might be required up front. Also, encouraging more group discussion throughout the session might have enabled detection of those who are confused by the game, so that they can be given further information either by the group or by the facilitator (e.g. see debrief in Session 1);

R3.2: Creativity support in the third level of dynamics needs a clearer facilitation structure and more active involvement of the game-master, and less reliance on the app, in order to keep the creative process on track. The players didn't reach the dynamics stages beyond Generating ideas, possibly due to lack of more structured facilitation. This was observed in all four session timelines;

R3.3: Clue representation has to pose a more balanced *Variable challenge* mechanic engagement, and attribute clearer meaning. Clues in the rooms of Hazel Court seemed to be either too obvious or too hidden, disturbing engagement with the *Collecting* mechanic (e.g. divergent thinking stages in Session 4);

R3.4: The Cluedo board and brainstorming from the point of view of characters were redundant - do a re-design of these resources or discard them in the digital prototype, in order to simplify input and engagement with the *Variable challenge* mechanic (e.g. see participants' comments in debrief in Session 2);

R3.5: A bigger screen for the app presentation is needed, or a projector facing a wall projecting the screen, to increase engagement and the focus of the players; because using a tablet mobile device seemed to limit collaboration and engagement with *Resource management* mechanic (e.g. see debrief in Sessions 3 & 4);

R3.6: Participants reading the game prompts out loud in the first level of dynamics seemed to add to the engagement of the group, and should be explicitly encouraged in the next version (e.g. see debrief in Session 4).

These recommendations were addressed in the re-design of the application of the digital prototype, described in the next section.

4.5 Hazel Court v2.1

This section is organised into two parts, reporting on: i) the new game features that resulted from the user feedback from the previous iteration; ii) the playtesting of the improved prototype, followed by the concluding recommendations for the final round of prototype design and development.

4.5.1 Game re-design

The motivation behind the game re-design was to improve the playtesting results on the CGBL dynamics and CSG user experience parameters. In *Hazel Court v2.1*, the main aims of the upgrades were:

- the representation of the game resources (e.g. clues);
- the utilisation of the existing *Hazel Court v2.0* web app (i.e. the context of how the app is used is as important as the content itself);
- the human facilitation of the game-master role the context of the CGBL dynamics.

Re: R3.1, R3.6: More instructions were given at each of the game's stages by the game-master, and players were encouraged to discuss the information at all stages, read out loud the contents displayed by the web app, and communicate throughout the game play session. Consequently, players were encouraged to take more time for each creative process stage, and therefore the planned length of the session was increased to 75-90 minutes.

Re: R3.2: Introducing a more defined structure and “plan Bs” for the game-master, and providing additional explanations and examples for the players in the third level of the game dynamics. For example, these included ground rules for brainstorming (*Anything goes; Build & credit; Go for quantity; Have fun*), and a reminder for headlining ideas when brainstorming (*How to...; I wish...; Wouldn't it be nice to...*) [129, 166]; these prompts were printed on paper and put up on the wall of the training room. Creativity triggers [52, 116], were also introduced to support the *Selection* stage in the third level of dynamics, adapted from the *My Home Life* recommendations for good person-centred dementia care (see Section 2.3.2): *Maintaining identity*, *Sharing decision-making*, and *Community building*; which are defined in [132] (Figure 4-24), accompanied by images to additionally prompt the theme behind a trigger. To prepare for this upgrade in creative facilitation, I undertook additional training in running creativity workshops, organised by the Centre for Creativity in Professional Practice, City University London in month M19 of the project, which provided me with hands-on tips and practice in facilitation (i.e. how to lead a creative workshop from a beginning to an end, with a focus on brainstorming techniques).

Re: R3.3: The game-master was asked to clarify the challenge and purpose of clue collection from the beginning of the game play. Physical objects were better hidden in the room, other found objects that were not part of the game were also welcome (e.g. whatever participants pick from the actual room of the care home), and they were utilised more actively as a resource in creativity techniques application (Figure 4-24).

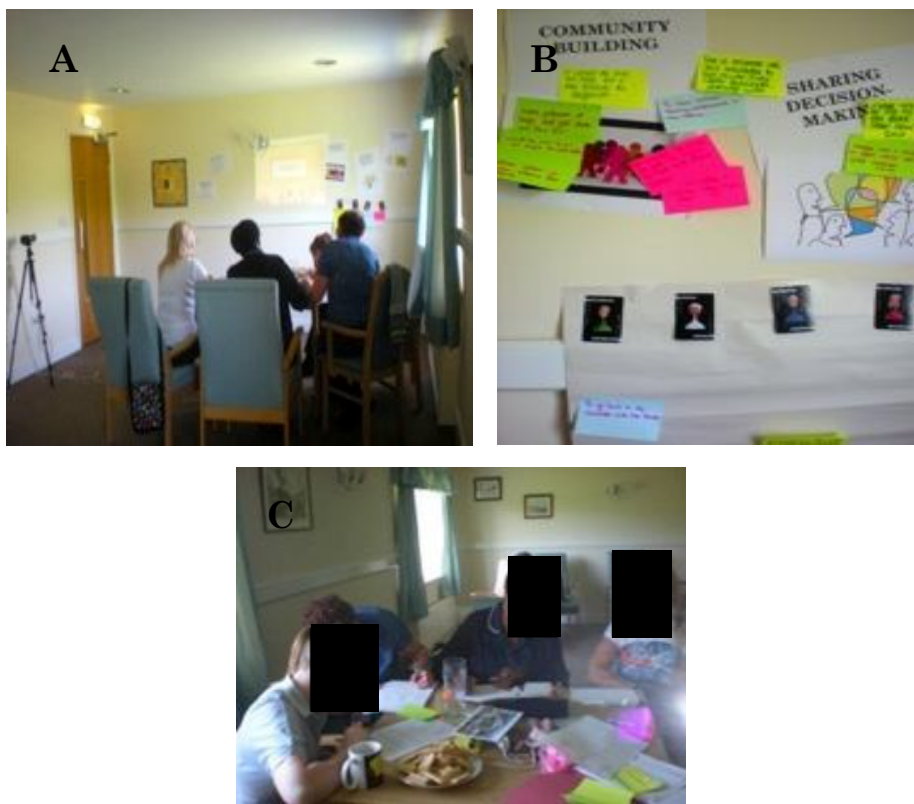


Figure 4-24: Some of the design improvements in Hazel Court v2.1, from left to right: a) projection of the web app on the wall to enhance visibility among the players, Cluedo board and other prompts on the walls; b) creativity triggers and flipchart for generating ideas; c) new function of the treasure hunt and physical clue objects.

Re: R3.4: The Cluedo board was to be put on the wall of the training room, to be visible as an illustration supporting the narrative setting, but without direct use by players as a game resource. Players were not instructed to brainstorm from the role of their characters, but were given the general brainstorming instructions, as described in Re: R.3.2.

Re: R3.5: A projector was introduced in order to engage everyone equally in collaboration. Interaction with the web app was displayed on the wall of the training room (Figure 4-24).

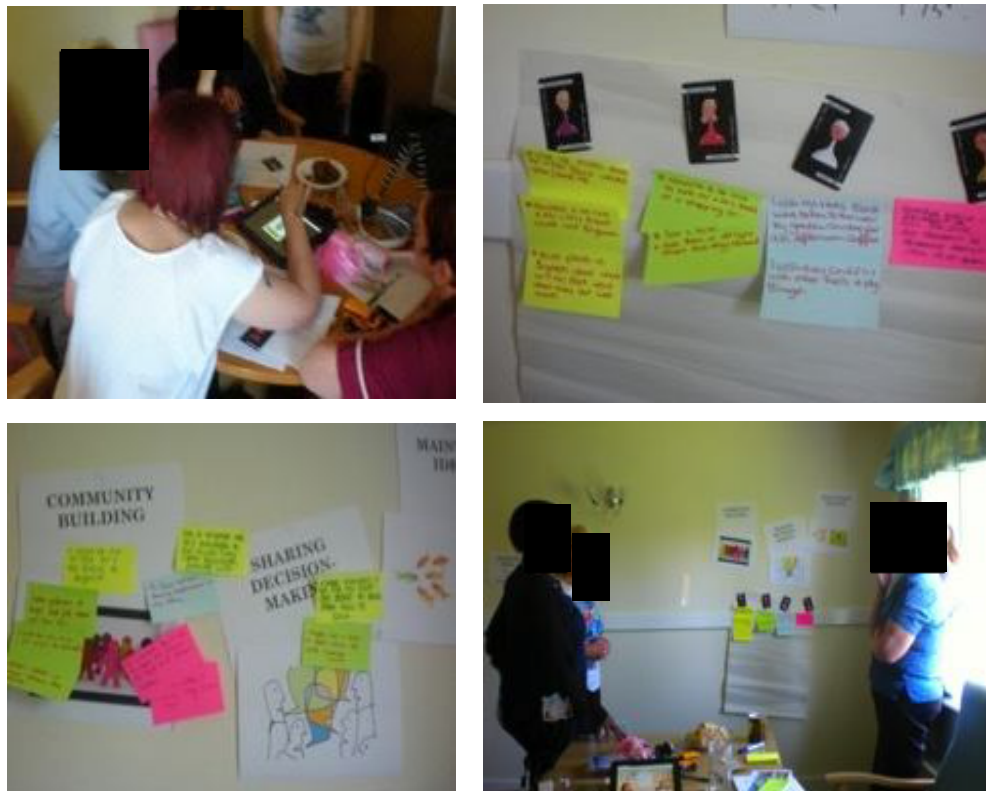


Figure 4-25: Photos from *Hazel Court v2.1* playtesting, illustrating several different CGBL dynamics stages, from top left to bottom right: a) clue gathering; b) generating ideas; c) creativity triggers used for idea selection; d) externalising the ideas and discussing the potential application in practice (i.e. transfer from excursion).

The support for the individual CGBL dynamics stages was therefore significantly refined. The first level of the game dynamics, supporting divergent thinking using digital clues provided by the web app, was more actively facilitated by the game-master, to ensure better engagement with the contents, clarity and encouragement of collaboration amongst participants (Figure 4-25). The third level of dynamics employed the web app only as a resource, whilst the creativity support facilitation throughout the levels was more actively led by the game-master (Figure 4-25). The *Hazel Court v2.1* dynamics are summarised in relation to the supporting CGBL mechanics in Figure 4-26, implementing the changes discussed in *Re:R3.1-R3.5*.

Description of activity	The CGBL dynamics	The CGBL mechanics
Introduction: the game-master explains the context and creative learning objectives of the game (as reported in Section 4.3.1.3) in detail, and reads out aloud the instructions to the players, before encouraging the players to carry on reading aloud themselves in the next steps. Emphasize elements like listening to the character's stories, collecting clues along the way, that there are no right or wrong answers, working as a team.	Find and formulate the problem	RM, Cu, Co, VC
Meet the Blacks	Acquire knowledge relevant to the problem	
Meet the other characters		
Kick-off in the Hall		
Exploring Room 1	Gather a broad range of potentially related information	
Exploring Room 2		
Treasure hunt		
Re-examining the collected clues: the game-master introduces brainstorming how-to ground rules and asks players to examine the clues and discuss their meaning, and write down associations on post-its	Generate a large variety of ideas	RM, Cu, F
The game-master asks participants to individually combine these associations and build them into ideas for care plan changes for Mr and/or Mrs Black, relevant to the story. The game-master introduces headlining as a help if needed, and invites them in turn to share with the group. When sharing, they put their post-its on the pre-prepared flipchart with columns headered with their character cards.	Combine ideas in unexpected ways	
The game-master suggests that they stand up again, investigate the flipchart, take the ideas they like best (their own or by other group members) and sort them into creativity triggers categories, by moving post-its, and then discuss the meaning of their ideas in these particular contexts. Players are asked to identify a trigger they find most intriguing, and then use it as a relevant criteria for selection of the best ideas.	Select the best ideas, applying the relevant criteria	
Players are asked to externalise one final idea that would be either one idea from the selected set ,or an idea made by combining of ideas from the selected set, and to elaborate on it in the transfer-from-excursion context.	Externalise the idea using materials and representations	

Figure 4-26: The *Hazel Court v2.1* dynamics description (see Section 3.3.4),
where: RM - Resource management; Cu - Customisation; Co - Collecting;
F - Feedback; VC - Variable challenge.

4.5.2 Playtesting

4.5.2.1 *Motivation*

The re-designed approach to the digital prototype application was playtested in the field with domain users, in order to evaluate whether the implemented upgrades in *Hazel Court v2.1* had an effect on the CGBL dynamics and CSG user experience results, in comparison with *Hazel Court v2.0*. Therefore, the objectives of the study were to:

- *OBJ1*: Investigate the dynamics of *Hazel Court v2.1* in the context of the CGBL framework, by analysing the coded timelines;
- *OBJ2*: Investigate the CSG user experience of *Hazel Court v2.1* in the context of the CGBL framework, by analysing the debrief questionnaire answers related to the assessment of the dimensions of a good CSG experience.
- *OBJ3*: Compare the results with the results of the previous playtest, and feed the lessons learned into the final design and development round.

4.5.2.2 *Method*

The playtesting involved 24 care staff participants in groups of four, distributed in six sessions over two days in month M21 of the project, at two RNHA care homes in Derbyshire, UK: Codnor Park Residential Home and Valley Lodge. I facilitated all the sessions, as the game-master. The participants were locals, both less experienced and more experienced carers working at the

organisation for at least six months. Two RNHA researchers were also present in the sessions. They contributed to the logistics and introduction of the sessions, but were not otherwise involved in the game playtest. Please refer to Appendix C-1 for the complete set-up checklist. The collected data were video recordings of the sessions, photos and debrief questionnaire responses.

Each session was estimated to last 90 minutes, and was planned as follows:

- *10-15 minutes* - Warm-up and explanatory instructions, where the session agenda was explained, the participants were introduced to the project and the role of creativity in dementia care, and could give their informed consent to the participation (Appendices B-2 & B-3);
- *20-25 minutes* - Divergent thinking using digital clues;
- *5 minutes* - Divergent thinking using physical clues (i.e. treasure hunt);
- *5-10 minutes* - Participants discussing the meaning of the gathered information and brainstorming simple associations to the gathered information (e.g. doll - child);
- *5-10 minutes* - Brainstorming ideas for activities these associations prompt; participants were encouraged to think about approaches they have not tried before in their practice (i.e. an emphasis on novelty);
- *5-10 minutes* - Sorting these ideas using creativity triggers and selecting the focus for the further development of ideas;
- *5-10 minutes* - Externalisation of one final idea and transfer from excursion technique, where the players were asked to share scenarios they experienced in real life when these ideas could be applied, as well as how they see

creativity techniques applied more generally in their practice;

- *5 minutes* - Completing the debrief questionnaire.

Attitudinal metric: The debrief questionnaire (Appendix C-2) asked participants to choose up to five adjectives from a list of 30 adjectives (10 positive, 10 neutral, 10 negative) that would apply to their experience with the game, as an adaptation of the Microsoft Product Desirability Testing method [11]. The questionnaire contained four open-ended questions, which were the same as the interview questions asked in the debrief of the previous playtest on dimensions of *Challenge*, *Freedom*, *Trust* and *Playfulness* (see Section 4.4.3.2).

Behavioural metric: Again, the game dynamics were analysed using the session timelines that I created using the collected video data, in the same format as for the previous playtest. The same coding scheme was used (see Tables 4-1 & 4-2 in Section 4.4.3.2).

4.5.2.3 *Results*

The debrief questionnaire results revealed some insights about the product desirability from the domain users' perspective; the mentioned impressions gathered from participants were the following: Helpful (17), Friendly (15), Engaging (12), Productive (10), Easy to learn (9), Valuable (9), Supportive (6), Understandable (6), Straightforward (6), Satisfying (5), Professional (4), Inviting (3), Familiar (3), Inspiring (2), Safe (2), Appealing (1), Confusing (1), Intuitive (1), Naïve (1), Predictable

(1) (Figure 4-27). This suggests that the carers found the CSG to be of an overall positive benefit, and both a valuable professional training and an engaging friendly experience.



Figure 4-27: Word cloud generated using the mention frequencies in the debrief questionnaire responses on Product Desirability test.

Furthermore, *Hazel Court v2.1* was revealed to be a more successful transfer-from-excursion trigger in the *Externalise the idea* dynamics stage than the previous prototype version, and overall better in providing convergent thinking support and a good CSG experience. This is illustrated by the responses some of the participants gave in the questionnaire, when asked about their experience with *Hazel Court v2.1*:

“It was an eye-opener and a reminder of how much more we could do to assist people with dementia to live a comfortable life.” [P1S2]
“I thought it was a good way of getting around the game and to get to know the characters and how they are similar to real life people.” [P2S1]
“It made me think about things I already know, but didn’t put into practice.” [P1S5]
“It was a good way of learning how to understand more about the situation, to get ideas of other people, share my own and work as a

team. The characters were good as they had life stories like real people.” [P4S6]

“It made me think about situations where I could improve verbal skills with the residents.” [P2S6]

“It made me think differently.” [P2S4]

“I really enjoyed the training. It helped me learn new skills and it was by far one of the best trainings I have had.” [P1S6]

“It was good to hear other people’s ideas, everyone’s feedback helped.” [P3S3]

“Felt confident to share ideas. The feedback helped me to see more ideas.” [P2S6]

“Interesting game and enjoyed making choices. A very different approach to training.” [P1S5]

“Yes it was fun and it made me feel good that I can communicate with residents.” [P4S4]

Four out of the six groups reacted very positively during both the debrief and the game dynamics, while two groups (Sessions 3 & 6) regarded it as useful, understandable and comfortable, but they were not fully engaged or challenged. These two groups were of very experienced care staff (10+ years of experience), and they would still strongly recommend it for less experienced staff. Another reason could be that these two were the last sessions for the day, and the game-master facilitator could have been tired and biased by the repetition.

Further insight about the behaviour of players in the interaction with the game mechanics was gained from the timelines that were created using the collected video data from the sessions, and analysed using the CGBL framework. The Session 5 sample was discarded from timeline analysis, due to the poor quality of video data from that session (i.e. participants’ behaviour and faces were not recognisable due to darkness in the room, created so that they could see the contents of the app projected on the wall, and the

video started from *Meet the characters* game event due to researcher's error). All other sessions ran according to the study design. The timelines analysis is provided in Appendix C-4.

Some groups were more successful at externalising their ideas (Sessions 2 & 3), but all of the groups were engaged in both divergent and convergent thinking phases of the CGBL dynamics. The participants seemed to engage with the game more than in the previous playtest, and the implementation of re-designed features was overall successful, especially in terms of the context setting, which was identified as the main barrier in the previous playtest. Overall, it was considered more engaging by the less experienced, younger staff (e.g. Session 1) than by the very experienced staff (e.g. Session 6).

Participants expressed a requirement for more freedom in the navigation of the contents (e.g. see divergent thinking phases in Session 3 timeline), which could be related to the constraints of the app as a tool for information gathering and exploration. Also, a need was expressed to continue to explore the board, and to experience more branching of the game narrative (e.g. see Session 6 timeline).

In the convergent thinking levels of the game dynamics, a need was recognised for favouring novelty over usefulness in the facilitation work with the participants in order to increase the overall creative appeal of the immediate outcomes of the game, as the participants often self-reported the ideas they have had to be useful but not something they have not tried before. In particular, the last phase of the convergent thinking in the CGBL dynamics

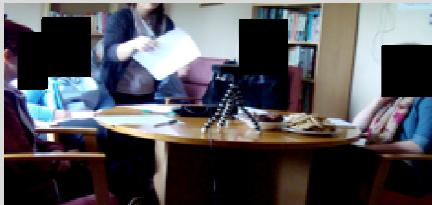
(“Externalise of the idea using materials or representations”) was not reached in most of the sessions, probably due to a lack of clearly defined materials or representations to assist players in the process. Some participants still managed to externalise one final generated idea (e.g. Session 4), but there were no means of following up on whether this idea was taken into practice afterwards or if the skills gained were utilised again in the working conditions.

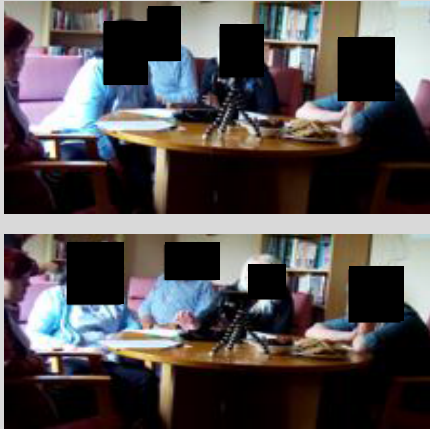
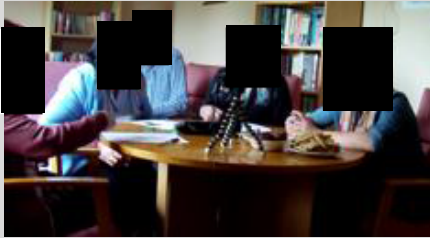
Session 1 (06/06/2013)

Participants: From left to right 1 activity organiser P1, 3 young female carers P2-P4, all with < 3 years of experience in care, F - facilitator, also present but not playing O1 and O2 - observers in the background;

Total time: 53:11 minutes, duration of play session: 49:33 minutes;

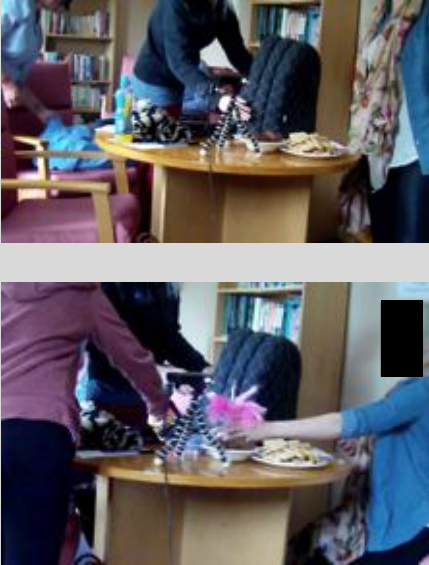
Source file(s): JunSession1.mov - camera angle facing the participants.

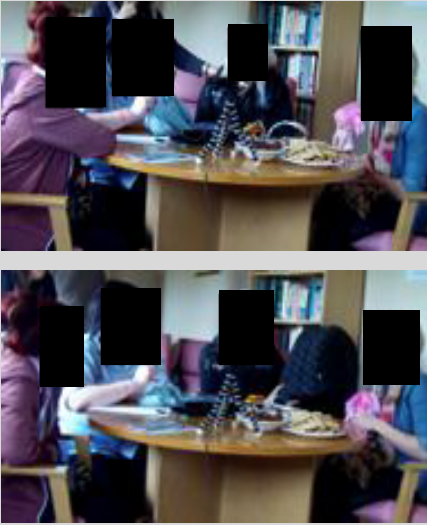
Time	Description of activity	Image	Mechanics (CGBL)	Dynamics (CGBL)	Notes
00:32	Introduction: F does the warm-up: explains the creative learning objectives of the game and the game premise, reads out the first two pages of the app, and explains how to use the app, what to pay attention to and what is going to happen along the way. F doesn't interact with the app, but encourages Ps to press Play and Next.		RM	1	The atmosphere in the room is a bit tense to start with, participants seem detached and not fully comfortable, but relax as they learn more on what the game is about. All participants know each other from before, as they work together.

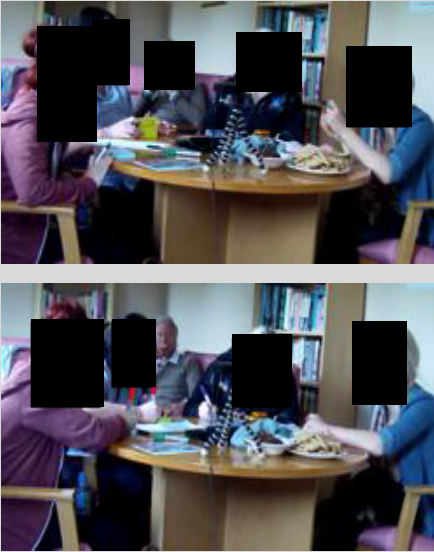
04:59	Meet the Blacks: F asks Ps to take over reading out loud, P2 takes lead. Judging by the body language, P2, P3 and P4 get more immersed in the game, while P1 seem still a bit reserved. They have a little giggle when meeting the Blacks. P3 says “What’s next?” and presses the button to take them forward.		RM	2	/
06:00	Meet the characters: P2 “Oh, Mr Green, Miss Scarlet!”; F says they can pick their characters, they are all familiar with Cluedo from before, so they enjoy exploring the character profiles and chatting about them, trying to pick the one they are most alike and counsel each other on the decision. F gives them card tokens.		RM, Co, F	2	/

08:04	They are on the Hall page, where the investigation begins. P3 says “I nominate Charlotte (P1) to read next”, therefore including the more shy participant in the game, and continuing to spontaneously take turns in using the app. P4 “I say Dining Room”, P2 “I agree with that”, P3 “I reckon Lounge”, but they eventually agree on Dining Room.		VC, RM, F, Cu	3	F closes the curtains - better view of the projected image the wall. Whenever there is a silence, F breaks it by a question/summary/clarification and then Ps carry on, and the flow of communication is kept.
10:02	Players are in the Dining room . Ps listen to what Miss Scarlet has to say, no problem finding the button. F hands out paper and post-its in case they want to take notes and encourages Ps to discuss what they've heard, and asks them if they've seen something else in the room, and Ps discuss the digital clue they've found (lady eating alone) and they think it must be Mrs Black and what it could mean.		RM, Co, F, Cu	3	/

12:28	They find Col Mustard in the Library. After hearing the audio, P2 decides to start taking notes to keep a summary of what they have so far. Ps discuss the clues and notice the digital clue (care plan). P3 “I think we should go to Conservatory next to learn more about what they like to do and what makes them happy”		RM, Co, Cu	3	The participants need less and less prompting to discuss the meaning of clues as the game goes on. They now notice digital clues without prompting.
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14:20	Treasure hunt introduction in the Conservatory. They collect the digital clue first (taxi driver's hat). P3 brings a catbed she finds on the top of the cupboard - not a designed clue, and tells everyone to put what they've found together at the table, and they put all of the clues inside the catbed, and then put it aside of the table to get ready for the next step. They talk about the clues and seem to enjoy the hunt; all Ps take part.		VC, RM, Co, Cu	3	The participants find clues that weren't implemented but the game adapts, emergent behaviour.
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17:13	Re-examining all the clues using the “whiteboard” page: F helps Ps to summarise their findings and asks them to brainstorm associations and talk about the meanings of the things they found. Ps focus more on the physical objects in front of them, taking them one by one. Each participant contributes equally to the conversation about the Blacks and other characters. The climate in the room is positive.		VC, RM, Cu, F	5	They don't write down the associations, but the conversation has a good flow. They like playing with the objects, e.g. P4 was caressing the doll during the entire exercise.
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22:52	Combining associations into headlined ideas about Blacks' care plan changes: Ps are successful in generating headlined ideas, but combination is not successful in a designed way, because they associations weren't written down in the previous step. However, when P2 shows the others one of her ideas (25:03), they stop brainstorming individually and discuss it, and talk about how to upgrade her idea, and then they continue to brainstorm individually. They put all the post-its in the middle of the table, attaching them to the paper where they took notes. P1 shares one of her ideas and others again stop to discuss and add, the same again happens when P4 shares one of her ideas. P1 sketches out some of her ideas spontaneously, and F encourages her drawing. At 29:30, they seem mostly finished, but F gives them 2-3 more minutes, and encourages them to re-look at the clues for more inspiration, and more ideas are added in result, and then asks Ps to share all they came up with (31:54) - 10+ headlined ideas. Their ideas are mostly activities-based. F asks them if they've tried something similar before to the proposed ideas, and they say they have, and reflect on the examples of their practice.		RM, Cu, F	5, 6	More emergent behaviour. Low novelty indicators.
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37:38	F introduces creativity triggers. Participants approach the wall and sort their ideas according to the triggers, and select the set around <i>Maintaining identity</i> to focus their attention further. Ps say that most of residents are not in late stages of dementia, so <i>Sharing decision-making</i> is easier. In turn, they discuss the meaning of triggers and reflect more on the examples from their practice when resolving challenging behaviours, making changes to care plans and coming up for new activities for residents.		RM, F, Cu	6, 7	/
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46:24	Transfer from excursion: participants reflect on the application of what they talked about in the session. P3 “When people don’t understand dementia, there are a lot of things that get brushed under the carpet, and that’s one thing something like this helps with, because you don’t think about taking them out and doing things with them, you just think about asking them ‘oh where did you use to live’ and just small talk...” (47:15), P2 “This made me see there’s always room for improving and trying new things”, P3 “Yeah I can’t see why we couldn’t try out all those ideas we created today...And we can go with our Sherlock Holmes hat and a pipe around the home after this”. P3 compliments P1’s work as activity organiser in their organisation. F wraps up with encouraging them to apply creativity techniques they learned in their everyday work. Ending at 49:33.		RM, F	/	Whilst discussion seemed rich with domain-specific benefits and directed towards the selected criteria, not one new approach was externalised in the final stage of the creative process, but rather a set of reflections on things that they’ve seen that work was exchanged between the participants. This suggests potential high usefulness and low novelty of outcomes. They seemed to well embrace the detective premise.
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Codes Sessions	CGBL Mechanics					CGBL Dynamics							
	Resource Management	Collecting	Customisation	Variable Challenge	Feedback	1	2	3	4	5	6	7	8
JUN1	11	4	7	3	7	1	2	4	/	2	2	1	/
JUN2	10	6	5	4	5	1	3	3	/	2	1	1	1
JUN3	10	5	1	4	4	1	3	3	/	3	1	1	1
JUN4	10	5	3	2	9	1	3	3	/	2	2	1	/
JUN5	7	5	3	4	5	1	2	3	/	3	1	1	/
Total JUN	48	25	19	17	30	5	13	16	/	12	7	5	2
AVG JUN	9.60	5.00	3.80	3.40	6.00	1.00	2.60	3.20	0.00	2.40	1.40	1.00	0.40

Table 4-4: The frequencies of the applied mechanics (Table 4-1) and dynamics codes (Table 4-2) per session (i.e. JUNx) and their average values.

The frequencies of the applied mechanics and dynamics codes per session (i.e. JUN x , where x is the session number) and their average values are shown in Table 4-4, following the example timeline. Addressing OBJ3, the results are compared with the results of the previous playtest (see Chapter 5). Finally, the key findings of timelines analysis are summarised in the form of nine design recommendations for the prototype improvement, presented in the next section.

4.5.2.4 *Conclusions*

The playtesting was fairly successful in delivering CSG training to care staff participants; based on the attitudinal results gathered by the debrief questionnaire (see Section 4.5.2.3), this version was more effective than *Hazel Court v2.0* in providing good CSG user experience. The timelines showed that the CGBL dynamics process was more complete and productive in the convergent thinking stages, and most of the relevant issues raised by the previous playtest were resolved. Furthermore, this formative evaluation resulted in nine recommendations for further development of the CGBL mechanics in *Hazel Court* CSG, both in terms of digital and physical components of the experience, *R4.1-R4.9*:

R4.1: The digital component could be improved by integrating an option that allows players to go back in the app and reconsider their choices, enabling **more freedom in navigation and Resource management** (e.g. see divergent thinking stages in Session 3, where participants engaged with

the objects within the game that were not implemented as the game resources);

R4.2: The prototype could also be expanded with more branching and **further development of the story and clue collection support features** (e.g. implementing game events in response to digital clue collection, as recommended by one user in Session 6);

R4.3: Creativity prompts of the **digital components should be updated to support the changes that were integrated into the physical facilitation of the convergent thinking stages** of the game dynamics. In the current game version, the game-master had no technology support in these phases of the game dynamics;

R4.4: Future versions of Hazel Court could contain **additional digital elements**, to the web app that would make the experience **more pervasively supported by technology** and, as a result, engage participants further in *Resource management*, *Collecting* and *Customisation* mechanics. In the current game version, the clue collection required a lot of continuous context setting by the game-master (Re:R3.1, R3.6), which could be overcome by modified uses of the technology, and my hypothesis was that it would bring even more player engagement;

R4.5: The creative process facilitation, provided by me as the game-master in this game version, could be documented in a way that would **allow the replication of the process with**

in-house trainers in care homes, making it a part of their regular induction training practice for care staff;

R4.6: Creativity techniques that were used to provoke idea generation and reflection could be adjusted further to favour novelty over usefulness, given the task-oriented mindset of care staff that is often an obstacle in providing person-centred care. Many ideas generated were self-reported as useful but not novel (e.g. see the final section of the Session 1 timeline). Indicated by this result, favouring novelty may lead to more emergent behaviours and involvement with the *Customisation* mechanic (e.g. see Treasure hunt event in Session 1, and convergent thinking stages in Session 4);

R4.7: Creativity techniques could support the last stage of the CGBL dynamics - idea externalisation more actively, to provide a more holistic end to the training, and hopefully leave players with a more developed immediate creative learning outcome as a part of the take-home message, leading to an outcome similar to what happened in Session 4, when the participants decided to implement an idea in their everyday practice;

R4.8: More activities could be implemented that would be followed afterwards in everyday practice on the creative professional skills application and ideas generated in the game (e.g. see Session 4 timeline);

R4.9: In terms of participants, it was discovered that the game is **most effective with less experienced care staff** and people in training, and could **especially benefit care staff that are decision makers and/or in position to organise activities for the residents** (e.g. see Session 1 with less experienced participants versus Session 6 with very experienced participants).

This formative evaluation was a valuable experience of overcoming obstacles from previous formative evaluations, and provided valuable guidelines for the final round of prototype design and development, and the summative evaluation in the final stage of the project. The main themes of the conclusions were that work should be taken further by: i) exploiting other means of digital support to the physical creativity facilitation in the CGBL dynamics; and ii) the mutual impact between creative climate and game mechanics for motivated learning that would target increased novelty ratings of immediate creative learning outcomes.

4.6 Hazel Court v3.0

Hazel Court v3.0 was a CSG prototype developed in collaboration with Simone Mora, a PhD candidate from NTNU in Norway, and myself, in months M26-M29 of the project. I was in the designer role, the facilitator role, and responsible for the playtesting of the game, whilst my colleague developed the hardware and software of the digital game components, and assisted me in some of the playtesting sessions. The game re-design used feedback from the

formative evaluation of *Hazel Court v2.1*, *R4.1-4.9*. To design and construct the new version of the *Hazel Court* serious game, we combined elements of the *Cluedo* board game, gamification software, and sensor-based technologies to enable embodied interaction and creativity techniques to generate new forms of the game mechanics to support carers to engage in the CGBL framework dynamics more effectively (see *R4.1-4.4*, *R4.5* & *R4.7* in Section 4.5.2.4).

In particular, the previous playtesting results suggested that the context setting, which depended previously on the game-master, could be undertaken with technologies (*R.4.4*). The new technologies could provide more freedom in the navigation of the game resources (*R4.1*), and better support convergent thinking phases (*R4.3*) and game responses to players' actions (*R4.2*). Furthermore, as discussed in the literature review (see Section 2.1.2.3) and some initial findings (*R1.5*), new sensor-based technologies for pervasive gaming can provide opportunities for player engagement and collaboration, to positively influence the outcome of playing a CSG.

The game was constructed for carers to play in two dynamics phases over 60 minutes:

1. The game play phase, during which carers explore the *Hazel Court* residential home using the detective metaphor to collect and investigate clues related to the challenging behaviour of two residents, Mr and Mrs Black;
2. The creative thinking phase, during which carers use the collected clues and three facilitated creativity techniques to

generate new and useful resolutions to the discovered challenging behaviours of the Blacks.

At the start of the game, carers place the pawn used to play the game in *Hazel Court's* hall on a game board, and the pawn displays a welcome image and plays audio instructions, amplified by a wireless speaker, to introduce game characters based on *Cluedo* characters, as in the previous versions: the carers Mrs White and Miss Scarlet, fellow residents Mr Green and Professor Plum, the nurse Mrs Peacock, and Colonel Mustard, who is the son of Mr and Mrs Black. Different storylines then lead the carers to different *Hazel Court* rooms, in which they can interact with the characters and find clues; the contents remained the same as the previous versions. Each clue can be discovered using a magnifying glass that vibrates when one is found during inspection of the room on a portion of the game board, and the clue box that plays a sound and prints out a logical association to each visual clue, showing a game's response to the player's action (see *R4.2* in Section 4.5.2.4). Once all of the *Hazel Court* rooms have been visited, the carers are told that more clues can be found in the physical room in which the game is being played, and are invited to take part in a treasure hunt. The carers can then scan each physical clue that is found with the same magnifying glass to print more clues from the clue box. The carers take these clues into the creative thinking phase, in which they use three facilitated creativity techniques to generate different new and useful resolutions to the discovered challenging behaviours of the Blacks.

To deliver the required CGBL mechanics and dynamics, the game was composed of four different types of resources. The first was an **interactive game board** based on the design of the country house depicted on the board of the *Cluedo* board game, as shown in Figure 4-30. The carers physically move the pawn around each game board to gather information clues about Mr and Mrs Black. Each game board was a customised hardware device, with embedded 13.56MhZ Near Field Communication (NFC) tags to link each room printed on the board with its digital representation in the game engine. The board game was designed to support the divergent thinking stages of the CGBL dynamics and hence specified emotional outcomes such as *joy*, *anticipation* and *surprise*.



Figure 4-30: One of the two Hazel Court v3.0 app game boards.

The second type of element was three computerised objects that were used during play on the game board: (1) **an interactive**

pawn that the carers move around each game board; (2) **an interactive magnifying glass** to discover clues on each game board, and; (3) **a printer box that prints clues** for carers to use, see Figure 4-31. The interactive pawn and clue box were both made from glued laser-cut wood sheets. The pawn had a 160x128-pixel LCD display. The magnifying glass was a conventional magnifying glass that has been extended to provide interactivity with embedded hardware LEDS and a vibration motor embedded in the handle to provide haptic feedback. The logic units of both the pawn and the magnifying glass were implemented with Seeed Xadow modules and an Arduino-compatible platform for embedded applications. Both had NFC readers with detachable antenna – the pawn’s antenna was located on the bottom of the box and magnifying glass’s antenna was close to the glass that acts as a way finder for NFC tags on areas of the game boards. The clue box contained a small thermal printer to print clues for the carers. All 3 objects had wireless connectivity that enables each to interact with the game engine via ZigBee adapters (series 1, 9600bps) on each end. The NFC tags allowed the pawn and magnifying glass to trigger digital operations such as playing a sound, displaying text and updating the game engine when the object is in close proximity (<5cm) to the tags. These three game objects were designed to enhance the same board game resource and support the divergent thinking stages of the CGBL dynamics to deliver emotional outcomes such as *joy*, *surprise* and *anticipation*.



Figure 4-31: Images, from top left to bottom right, of *Hazel Court*'s interactive pawn, magnifying glass, and clue box, and all elements together.

The third type of element was a set of **six physical clues** to the challenging behaviour of Mr and Mrs Black hidden in the room in which carers play before the start of the game. During the game, carers were encouraged to search for the clue objects – a music

CD, doll, toy car, shawl, set of headphones and an old £1 note – as part of a treasure hunt to find further evidence about the challenging behaviour of the Blacks. **Each object was also NFC-tagged**, so when scanned with the magnifying glass, a new associated clue was printed from the clue box. The six interactive clues were designed to deliver the treasure hunt and enable divergent thinking stages of dynamics more effectively.

Furthermore, the NFC-tagged game boards, physical clues and interactive pawn, magnifying glass and clue box all interoperated with gamification software that was composed of a game engine that implements fine-grain game rules that support the game's mechanics, and updates variables, a gateway that acted as the service bridge and network layer between the game engine and objects, and firmware that runs on each object to manage the embedded sensors, displays and actuators. The game engine was built in the Scratch visual programming language, and game rules were implemented in chains of blocks that broadcast and handle events from/to the objects. The gateway was implemented in Python, the scratch.py library and serial libraries. Bespoke firmware was developed for each object using the Arduino IDE to implement low-level logics for the electronics built into the objects in order to generate events after players' interactions with the objects and handle events received from the game engine. The game engine itself ran on standard (i.e. Windows and Mac) computers running Scratch, and its architecture was based on real-time event-driven messaging between the three objects and computer running it. Each event was generated either after a carer's tangible interaction with the objects, for example a carer moves the pawn to a new room, and therefore initiate an event in

the physical domain, or by the game engine from the digital domain. The engine handled each event with game rules to select audio and graphic contents to be displayed, and then returned messages to the objects.

The fourth type of game resource was associated with the facilitated creative thinking phase in which the carers first reflect on the clues discovered during the game play session to collaboratively learn about Mr and Mrs Black, then use the creativity techniques to generate new and useful resolutions to their challenging behaviours based on the clues, the same as in the *Hazel Court v2.1*. Reflecting about care and its effects on a resident was recognised as an important activity in person-centred care, and its convergent thinking tasks were based on activities such as sense-making from collected clues, re-evaluating these clues from different perspectives, and generating reflection outcomes.

The re-design was made for the final convergent activity, when the carers use the new ideas to design at least one new care outcome for Mr and Mrs Black that they have not tried in the care of their own residents. The carers were prompted with a **Who-When-Where-How chart** that was an adapted 5W1H technique for task analysis, which framed a situation by using these four questions [52] as a representation for externalising ideas, to reflect further about the new care outcome and discuss future possible uses of the investigation strategies and creativity techniques with their own residents.

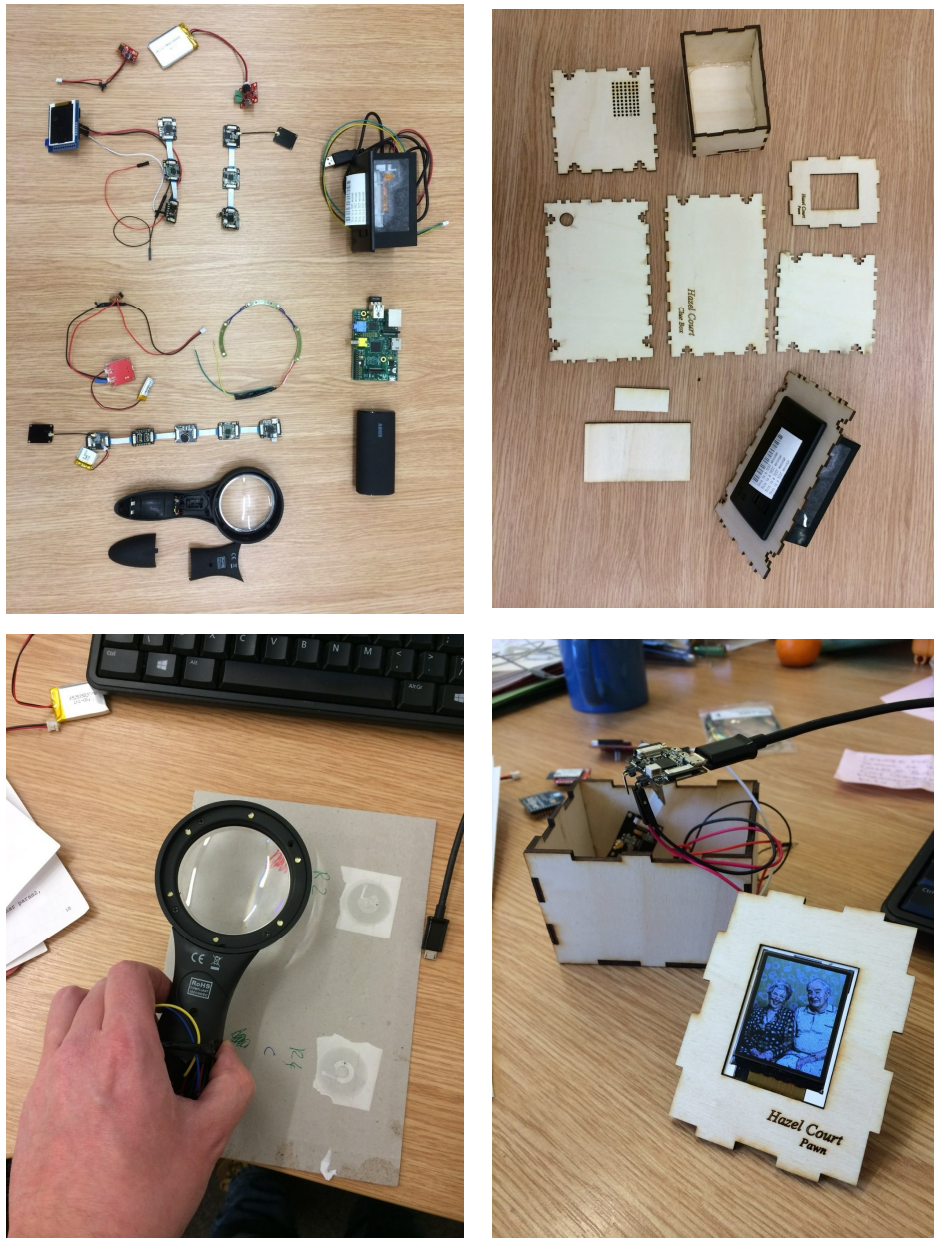


Figure 4-32: Making Hazel Court v3.0 hardware components.

The game prototype was internally piloted one week before the summative evaluation in one playtesting session in the lab setting, with colleague PhD students as participants. Only the basic usability elements were assessed, and the game was proved robust enough to be playtested in the field. Both game phases were played out, and the participants engaged in all stages of the

CGBL dynamics. With participants' consent, video data was collected in case of some complex issues arising, however, in the end there was no need for more analysis of this material.

In Chapter 6, I report on how *Hazel Court v3.0* was used in the summative evaluation with carers in seven residential homes to determine if it supported carers to experience the aesthetics of creative play described in the CGBL framework and generate more creative care activities compared to traditional care training workshops.

4.7 The chapter summary

This chapter reported on how I applied an iterative player-centred design process [62] in the development of a CSG prototype, which instantiated the CGBL framework in the domain of person-centred dementia care; starting from a mixed-method concept study (Section 4.2), followed by a paper-based prototype (Section 4.3), and three digitally-supported prototype versions of *Hazel Court* CSG (Sections 4.4, 4.5 & 4.6), *OBJ2* of the project was successfully achieved (see Section 4.1).

The main findings of the series of formative evaluations undertaken in the field with domain-users are summarised in Figure 4-33, in response to the research question that directed this outcome of design and development of the game prototypes that instantiate the CGBL framework (*Which game mechanics, game environment, player mode, artefacts and creativity techniques are the most appropriate to employ in a creative serious*

game (CSG) that instantiates the CGBL framework in dementia care training domain?). The resulting design recommendations *R1.1-R4.9* focused on the implementation of the five CGBL mechanics and eight phases of the CGBL dynamics for group collaboration in a care home training setting, and show the evolution of the design of the game resources, and exploratory, combination and transformative creativity techniques used to support both divergent and convergent thinking for this particular user group. The application of these findings resulted in the final prototype design (*Hazel Court v3.0*) that was revealed to be the most successful in instantiating the CGBL framework's mechanics and dynamics under the determined constraints of the application domain, identified in the course of the fieldwork formative evaluations.

Formative evaluation	Lessons learned
<i>Concept study</i>	<i>R1.1:</i> The proposal to use the <i>Other worlds</i> technique is effective as an implicit creativity support of the game environment, but CSG design requires other, more explicitly implemented creativity techniques to be supported by the mechanics instantiation in order to provide more structure to the CGBL dynamics (i.e. the creative process); <i>R1.2:</i> Implementation of the mechanics and designer-generated resources needs to support case scenario contents that are semantically closer to the user domain; <i>R1.3:</i> Implementation of the mechanics and designer-generated resources needs to support case scenario contents that are clearly formulated and presented, and not too dense with information. This will allow freedom for creativity and interaction amongst players to emerge; otherwise, they may end up being too busy inspecting resources rather than building on them; <i>R1.4:</i> Teamwork in a multiplayer training setting proved to be a significant component of engagement in this domain, and is also something to be encouraged by the mechanics; <i>R1.5:</i> In order to support the CGBL dynamics, mechanics should be implemented in a way that combines physical and digital resources.
<i>Hazel Court v1.0 (physical prototyping)</i>	<i>R2.1:</i> Introduce digital elements in a way that preserves the positive aspects of physical interaction (e.g. tactile, present, integrated in the physical game space, more easily shared and discussed in real-time), because it seems to be an important for the CGBL aesthetics of <i>Trust</i> and <i>Joy</i>; <i>R2.2:</i> Refine the second level of the dynamics by changing the nature of the clues in the treasure hunt, making them semantically closer to the domain; <i>R2.3:</i> Refine the third level of the dynamics by introducing more facilitation of the techniques supporting convergent thinking; <i>R2.4:</i> Refine clues representation in a way that makes them more integrated and accessible.
<i>Hazel Court v2.0 (digital prototyping)</i>	<i>R3.1:</i> More context setting is needed for the first level of dynamics. Several people from different groups found themselves confused and unsure of what was going on for the first 15 minutes (e.g. see debrief in Sessions 2, 3 & 4). This indicates that more explanation and set-up might be required up front. Also, encouraging more group discussion throughout the session might have enabled detection of those who are confused by the game, so that they can be given further information either by the group or

	by the facilitator (e.g. see debrief in Session 1); <i>R3.2:</i> Creativity support in the third level of dynamics needs a clearer facilitation structure and more active involvement of the game-master, and less reliance on the app, in order to keep the creative process on track. The players didn't reach the dynamics stages beyond Generating ideas, possibly due to lack of more structured facilitation. This was observed in all four session timelines; <i>R3.3:</i> Clue representation has to pose a more balanced <i>Variable challenge</i> mechanic engagement, and attribute clearer meaning. Clues in the rooms of Hazel Court seemed to be either too obvious or too hidden, disturbing engagement with the <i>Collecting</i> mechanic (e.g. divergent thinking stages in Session 4); <i>R3.4:</i> The Cluedo board and brainstorming from the point of view of characters were redundant - do a re-design of these resources or discard them in the digital prototype, in order to simplify input and engagement with the <i>Variable challenge</i> mechanic (e.g. see participants' comments in debrief in Session 2); <i>R3.5:</i> A bigger screen for the app presentation is needed, or a projector facing a wall projecting the screen, to increase engagement and the focus of the players; because using a tablet mobile device seemed to limit collaboration and engagement with <i>Resource management</i> mechanic (e.g. see debrief in Sessions 3 & 4); <i>R3.6:</i> Participants reading the game prompts out loud in the first level of dynamics seemed to add to the engagement of the group, and should be explicitly encouraged in the next version (e.g. see debrief in Session 4).
<i>Hazel Court v2.1 (digital prototyping)</i>	<i>R4.1:</i> The digital component could be improved by integrating an option that allows players to go back in the app and reconsider their choices, enabling more freedom in navigation and <i>Resource management</i> (e.g. see divergent thinking stages in Session 3, where participants engaged with the objects within the game that were not implemented as the game resources); <i>R4.2:</i> The prototype could also be expanded with more branching and further development of the story and clue collection support features (e.g. implementing game events in response to digital clue collection, as recommended by one user in Session 6); <i>R4.3:</i> Creativity prompts of the digital components should be updated to support the changes that were integrated into the physical facilitation of the convergent thinking stages of the game dynamics. In the current game version, the game-master had no technology support in these phases of the game dynamics; <i>R4.4:</i> Future versions of Hazel Court could contain additional digital

	elements, to the web app that would make the experience more pervasively supported by technology and, as a result, engage participants further in <i>Resource management</i>, <i>Collecting</i> and <i>Customisation</i> mechanics. In the current game version, the clue collection required a lot of continuous context setting by the game-master (Re:R3.1, R3.6), which could be overcome by modified uses of the technology, and my hypothesis was that it would bring even more player engagement; <i>R4.5:</i> The creative process facilitation, provided by me as the game-master in this game version, could be documented in a way that would allow the replication of the process with in-house trainers in care homes, making it a part of their regular induction training practice for care staff; <i>R4.6:</i> Creativity techniques that were used to provoke idea generation and reflection could be adjusted further to favour novelty over usefulness, given the task-oriented mindset of care staff that is often an obstacle in providing person-centred care. Many ideas generated were self-reported as useful but not novel (e.g. see the final section of the Session 1 timeline). Indicated by this result, favouring novelty may lead to more emergent behaviours and involvement with the <i>Customisation</i> mechanic (e.g. see Treasure hunt event in Session 1, and convergent thinking stages in Session 4); <i>R4.7:</i> Creativity techniques could support the last stage of the CGBL dynamics - idea externalisation more actively, to provide a more holistic end to the training, and hopefully leave players with a more developed immediate creative learning outcome as a part of the take-home message, leading to an outcome similar to what happened in Session 4, when the participants decided to implement an idea in their everyday practice; <i>R4.8:</i> More activities could be implemented that would be followed afterwards in everyday practice on the creative professional skills application and ideas generated in the game (e.g. see Session 4 timeline); <i>R4.9:</i> In terms of participants, it was discovered that the game is most effective with less experienced care staff and people in training, and could especially benefit care staff that are decision makers and/or in position to organise activities for the residents (e.g. see Session 1 with less experienced participants versus Session 6 with very experienced participants).
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Figure 4-33: The summary of the formative evaluations' findings.

Chapter 5 – Implications from the formative evaluations for the CGBL framework instantiation

5.1 Introduction

This chapter aims to refine the CGBL framework with the additional guidelines for the future CSG designers, focusing on the process of the CGBL framework instantiation. The design and development of *Hazel Court* CSG revealed additional design factors that were not in the original framework. A need emerged to add more CSG design and development support to the framework. The domain-independent CGBL framework reported in Chapter 3 described the structure and use of a CSG. However, each of the framework's instantiations will require the customisation of its components in the CSG design for a particular user group, and the guidelines presented in this chapter aim to inform that process.

The lessons learned from a Designer's point of view during the formative evaluations reported in Chapter 4 informed the method to instantiate the framework. It is important to underline that the generalisability of the conclusions drawn from this single iterative CSG design process case study is to be taken with caution, unless validated by future studies. However, as the CGBL framework is part of an exploratory research of creativity support in serious games, the CSG designers could benefit from this contribution to the framework refinement.

Next, I will report on the three major themes identified in the implications for the CGBL framework instantiation: the instantiation of the CGBL mechanics (Section 5.2); the instantiation of the CGBL dynamics (Section 5.3); and the player

mode and facilitation (Section 5.4). In conclusion, as a refinement of the CGBL framework inferred from the conducted formative evaluations, I propose ten general methodological guidelines (*G1-G10*) for the CGBL framework instantiation (Section 5.5).

5.2 Implications for the instantiation of the CGBL mechanics

The implementation of the five CGBL mechanics generated a set of designer-generated resources, which are highly domain-dependent. As seen in the formative evaluations, the settings of the CGBL mechanics instantiation need to be discovered and iteratively adjusted by a Designer in collaboration with Players, to adapt the game's physical and digital prototyping. Therefore, the effects on the CGBL dynamics (Section 5.2.1) and dimensions of CSG experience (Section 5.2.2) have to be considered.

G1: The settings of the CGBL mechanics instantiation need to be discovered and iteratively adjusted by a Designer in a series of formative evaluations with the Players, from the concept study, to the physical and digital prototyping. Using Players' feedback to inform the prototypes, will lead to a decrease in the level of abstraction of the CGBL mechanics' specification, and an increase in the level of robustness of the prototype.

CSG design (i.e. the CGBL framework instantiation), like game and most other forms of design, is an iterative process. This means that the game is quickly prototyped, playtested and

refined, again and again, before it is finalised [62], as the method that I applied in the formative evaluations of *Hazel Court* CSG. The concept study investigated the basic functionalities of the CGBL mechanics, and the physical prototyping extended the concept with the early-version of the CGBL dynamics and designer-generated resources. The digital prototyping refined the CGBL dynamics, and explored how to manage the emerged factors of group collaboration and integrated facilitation. More iterations of digital prototyping could have been conducted to further investigate the dependency between the CGBL mechanics and dynamics, but were not deemed necessary.

5.2.1 The dependency between the CGBL mechanics and the CGBL dynamics

The comparison between the average frequencies of the assigned mechanics codes from the playtest results of *Hazel Court v2.0*, reported in Section 4.4, and *Hazel Court v2.1*, reported in Section 4.5, is shown in Figure 5-1. The conducted studies provided more insight about the impact of activation of each of the CGBL mechanics during the CGBL dynamics (see Figure 3-6 in Section 3.3.5).

G2: Depending on the Players' feedback, the CGBL mechanics can be designed to be more or less activated in the CGBL dynamics than proposed by the CGBL framework.

The instantiation of the mechanism of *Customisation* is an example of a beneficial decrease in the activation than compared to what is proposed in the CGBL framework. The comparison revealed increased engagement during the playtests in all CGBL mechanics except *Customisation*. This result was somewhat expected and can be explained by the design trade-off that was made, which introduced a clearer structure, more facilitation and explanation (in response to *R3.1*, *R3.2* and *R3.3*) and led to better functioning of the other four mechanics. However, this allowed less freedom for *Customisation* to occur in some of the dynamics stages. Whereas the CGBL framework suggests the activation of the *Customisation* mechanism throughout the CGBL dynamics, it peaked only in the convergent thinking stages (e.g. see *Hazel Court 2.1* Session 5).

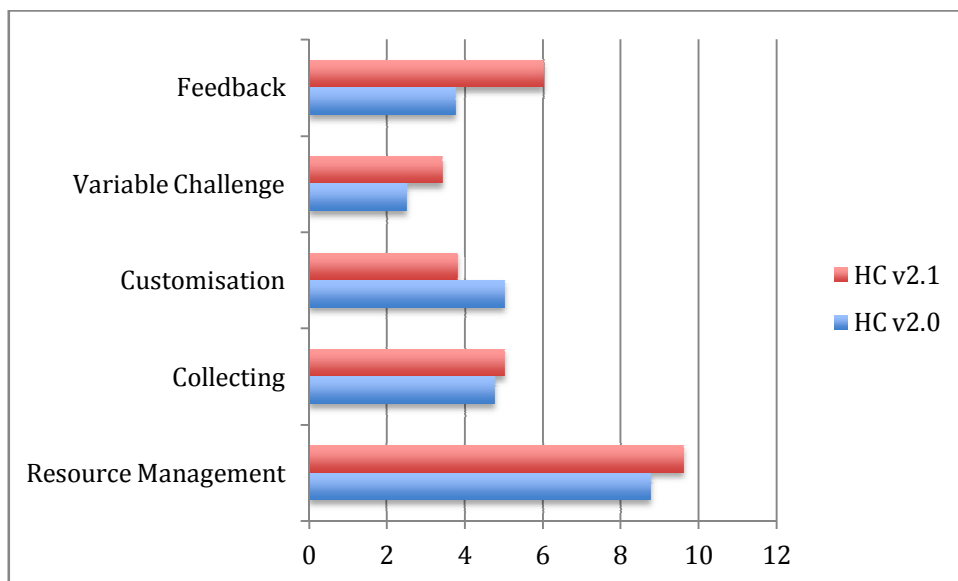


Figure 5-1: The comparison of the average occurrences of the assigned mechanics codes (see Table 4-1) between *Hazel Court v2.0* & *Hazel Court v2.1*.

In contrast, an example of a beneficial increase in activation beyond what the CGBL framework proposes emerges through the instantiation of the *Feedback* mechanism. The most notable change in the mechanics distribution between the two game versions was the increased use of the *Feedback* mechanism, which was especially targeted by game re-design actions based on recommendations R3.1, R3.2 and R3.6 from *Hazel Court 2.0* playtest. Moreover, in *Hazel Court v2.1*, the *Feedback* mechanism was often present in all stages of the CGBL dynamics. The CGBL framework relates this mechanism with the convergent thinking phases, but the playtest results suggested the benefits of designing domain-specific collaboration and discussion amongst the players throughout the CGBL dynamics.

G3: A Designer should remain flexible during the iterative playcentric design process, be ready to make trade-offs when balancing the CGBL mechanics and dynamics, continuously learn from the data at hand, and systematically project that knowledge to the CGBL mechanics re-design in the next iteration.

Some examples of this practice are the balancing of the mechanics of *Collecting*, *Variable challenge* and *Resource management*. The slightly increased use of the *Collecting* and *Variable challenge* mechanics is possibly a consequence of the game re-design actions based on recommendation R3.3. The slight increase in use of the *Resource management* mechanism might have been a joint consequence of game re-design actions taken on R3.1, R3.2 and R3.5 related to the context setting within the CSG. This mechanism was activated throughout the game. Since *Hazel*

Court v2.1 prolonged the game play and refined its stages, the activation of this mechanic was intensified.

5.2.2 The dependency between the CGBL mechanics and the dimensions of good CSG experience

The dependencies between the dimensions of a good CSG experience (i.e. Challenge, Trust, Freedom, Idea-support, Idea-time, and Humour & playfulness) and the CGBL mechanics (i.e. Resource management, Collecting, Customisation, Variable challenge, Feedback) were described theoretically in the CGBL framework in Section 3.3.5. Each CSG play session is to be constructed by a Designer who seeks to afford each of the dimensions by implementing the mechanics in a most effective way for each application domain. However, the framework did not address how the balancing of the dimensions would effect the balancing of the mechanics, and vice versa. Only the data collected during the formative evaluations informed the dependency between these two CGBL components further.

G4: Evaluation of the dimensions of a good CSG experience in each design iteration, and in particular in the early iterations, inform the Designer of what works well and what needs improvement in the next mechanics re-design, and help to keep track of the overall progress towards the goal of positive CSG outcome. This task can be done using methods that include debrief interviews, user observations, and debrief questionnaires.

Looking at the feedback provided by the users in *Hazel Court v2.0* debrief, the recommendations focused on the need to increase the experience related to the dimension of Challenge (in turn related to the Variable challenge, Resource management, and Collecting mechanics), Trust (related to the Feedback, Resource management and Collecting mechanics) and Idea-support (related to the Feedback mechanics). The CSG re-design addressed these issues, which can be observed in the described changes in the mechanics activation (Figure 5-1). Triangulating this result with the debrief questionnaire replies, participants were more satisfied with the challenge, collaboration and creative process that the game facilitated. Structuring and constraining the CSG to allow these re-design actions resulted in slightly lower activation of the Customisation mechanism, and had some impact on the experience of Freedom dimension (e.g. in replies to debrief questionnaire, several participants expressed a wish to explore more rooms and scenarios in *Hazel Court v2.1*).

What I learned from this is that the balancing of the CGBL mechanics and domain-related trade-offs is likely to occur during the iterative playcentric design process of the instantiation. To this end, the six dimensions of a CSG experience are, from my experience of the formative evaluations of a CSG, more straightforward to assess than the users' emotions (i.e. the CGBL aesthetics) or creative learning outcomes, especially in the early prototyping stages. This could be because the achievement of the dimensions is dependent on an overall positive CSG outcome, which includes both the CGBL aesthetics and the creative learning outcomes. Therefore, the method can provide quicker game- and CPS-related feedback to a Designer.

In the earlier playtests, such as with *Hazel Court v1.0*, the analysis of dependency between CSG user experience and the implementation of the CGBL mechanics gave quick indications of a CSG outcome, and how to further adjust the mechanics to improve the CSG outcome. In this case, the recommendations focused on the issues related to a need to increase the Challenge and Idea-support dimensions of the CSG experience. These issues were eventually resolved and resulted in more positive CSG outcome of *Hazel Court* CSG overall, as demonstrated with *Hazel Court v3.0*.

G5: When there is sufficient evidence of the dimensions of the good CSG experience from the prototype playtests, the Designer should then evaluate the CGBL aesthetics and creative learning outcomes in relation to the CGBL mechanics. This task can be done using methods such as debrief interviews, user observation, follow-up questionnaires, and diary study.

When a prototype is robust enough, the analysis of a CSG outcome can focus on the aesthetics and creative learning outcomes in relation to the mechanics, with a benefit of deeper understanding of the effects of the mechanics activation (see Chapter 6).

5.3 Implications for the CGBL dynamics instantiation

In the case of *Hazel Court* CSG design and development, the earliest prototyping work focused on fostering mainly divergent thinking. Then, in the phase of physical prototyping, when the concept was formed and the basic instantiation of the five CGBL mechanics was determined, convergent thinking was added into the CGBL dynamics process. Only when the prototype became more robust and the needs of users were better understood, were the CGBL mechanics adjusted to support the refined CGBL dynamics of the 8-phased Sawyer's model of creative process (Figure 5-2).

G6: The abstraction level in the implementation of the CGBL dynamics can gradually decrease as the prototyping process advances, from the 3-phased creative process model towards the 8-phased creative process model.

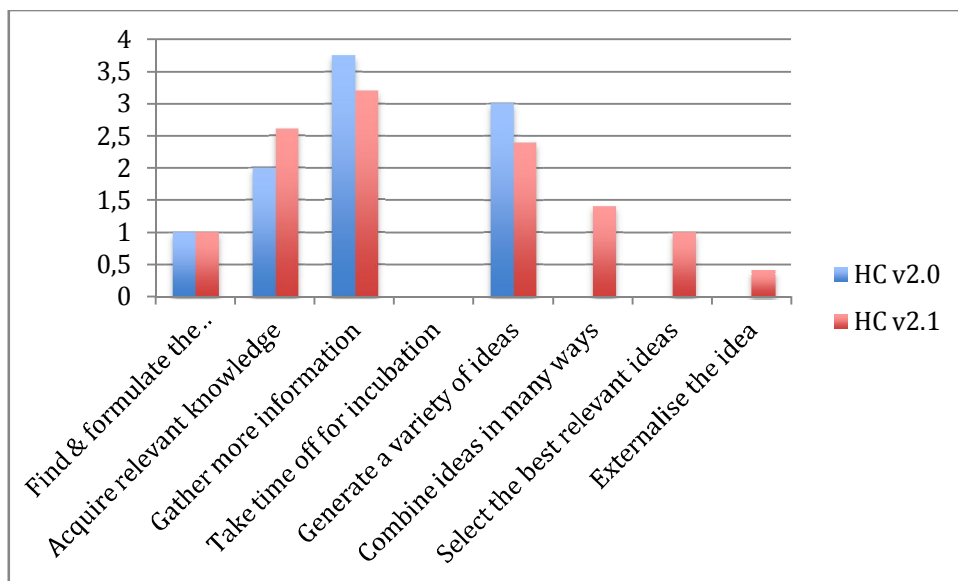


Figure 5-2: The comparison of the average occurrences of the assigned dynamics codes (see Table 4-2) between *Hazel Court v2.0* & *Hazel Court v2.1*.

The comparison between the *Hazel Court v2.0* and *Hazel Court v2.1* playtest results showed that the 8-phased CGBL dynamics process was more complete and productive in the convergent thinking stages in the case of the *Hazel Court v2.1*, and most of the relevant issues raised by the previous playtest were resolved. The comparison between the *Hazel Court v2.0* and *Hazel Court v2.1* playtest results by average frequencies of the assigned dynamics codes confirmed better support for the convergent thinking stages, as required by *R3.2*.

G7: The refinement of the CGBL dynamics, from the 3-phased to the 8-phased creative process model, depends on the evolution of the CGBL mechanics in the iterative playcentric design process. Some factors worth considering before the refinement is made are: the creativity techniques that were most compatible with the user group; the appropriate level of the concept's semantic distance from the domain; the choice and style of facilitation; designer-generated resources that supported the creative process; the usability of the technology supporting the creative process; and the timing involved in each stage of the creative process.

The re-design of the CGBL mechanics, using the CSG user experience feedback was crucial in ensuring complete coverage of the refined divergent (stages 1-3 in Figure 5-2) and convergent thinking stages (stages 5-8 in Figure 5-2) of the CGBL dynamics. In particular, the design challenge, reflected in several recommendations (see Section 4.7), was to make design choices about: the creativity techniques that were most compatible with the user group (e.g. *R4.7*); the appropriate level of the concept's

semantic distance from the domain (e.g. *R1.2*); the choice and style of facilitation (e.g. *R2.3*); designer-generated resources that supported the creative process (e.g. *R1.3*); the usability of the technology supporting the creative process (e.g. *R4.4*); the timing involved in each stage of the creative process (e.g. *R3.1*). The original CGBL framework did not take these factors into consideration when describing the dependency between the CGBL dynamics and the CGBL mechanics (see Figure 3-6 in Section 3.3.5). Being aware that these factors may influence the positive CSG outcome can help Designers to plan their design activities.

G8: Incubation is a stage of the CGBL dynamics that can be omitted in CSG design, without major consequences for the positive CSG outcome.

Incubation (the fourth stage in Sawyer's creative process model, see Figure 5-2) is a stage that could not have been implemented in *Hazel Court* CSG, due to time constraints of the playtests, and given one-off exposure time with participants in the field. Incubation can sometimes take more than one game-play session. In spite of findings from previous research [89], incubation is not always necessary in a creative process. There is extensive evidence of achieving creative outcomes in facilitated conditions that allowed no time for incubation [162]. However, future CSG designers may need to implement incubation in a way that satisfies the constraints of the fieldwork evaluations. Also, this stage of the CGBL dynamics could have different levels of importance in different application domains, depending on the user group properties and goals, therefore this guideline should be taken with particular caution.

5.4 Player mode and facilitation

Two factors that were not considered by the CGBL framework were discovered to be particularly influential in the formative evaluations in the case of *Hazel Court* CSG: player mode (i.e. playing as a team as preferable to the single-player mode, where the team consists of players of diverse backgrounds), and facilitation (i.e. integration of a game-master).

G9: A Designer should consider implementing team-player mode, rather than single-player mode or between-player competition, and adjust the instantiation of the CGBL components in the CSG design accordingly.

Group collaboration in the creative process was found to be preferable in the case of training carers in person-centred dementia care. Related work showed that carers would benefit from motivated learning that strengthens the practice of empathy, teamwork and sharing of professional experiences [128, 133] in search of novel and useful solutions to their professional challenges [114]. In Chapter 3, it was already discussed that competition and conflict should not be encouraged (see Section 3.2.6). My formative evaluations supported those findings with positive CSG outcomes of the playtesting sessions, even though no comparison was conducted with a single-player mode. Replies to the debrief interview questions and questionnaire reflected satisfaction with the opportunity to be able to collaborate and create together (e.g. see Section 4.5.2.3). However, this guideline

is to be taken with caution, as in some other domains, with a stronger requirement for individual rather than group creativity, it may be useful to consider implementing single-player mode.

Playing as a team has further implications for CGBL instantiation, in particular the designer-generated resources and CGBL dynamics. Creativity techniques integrated in a CSG have to be appropriate and adapted to a group application in order to produce effective collective creations [161]. Diverse backgrounds and reactions of the players have to be taken into consideration. There has to be a variable for managing this heterogeneous input in real-time, and in the case of *Hazel Court* CSG, that has been achieved through implemented human facilitation (i.e. the game-master).

G10: A Designer should consider implementing some form of creative process facilitation in the CGBL mechanics and designer-generated resources, in order to increase the prospects of a positive CSG outcome.

The game-master was first introduced in *Hazel Court v2.0* (see Section 4.4.1.2). Whilst potentially being a source of bias and inhibiting the reproducibility of the CGBL dynamics, its support mechanics were revealed to benefit the positive CSG outcome of the sessions. Formative evaluations revealed the creativity support element of the facilitation to be particularly beneficial for the players with no CPS experience. Other factors the game-master managed include the condition of the complexity of group creativity, and various levels of professional and technology experience.

However, not all the CSGs have to have game-masters. It is left for future work to explore other agents, both human and non-human, such as game technologies, to support the activation of the CGBL mechanics and dynamics in real-time, if determined as required in the particular domain. For example, if a CSG is made for professional designers to practice creative thinking, the players may need no facilitation of the creative process as they already have some previous expertise.

5.5 Conclusion

I would recommend applying the guidelines presented in this chapter when instantiating the CGBL framework as a Designer. These implications, summarised in Figure 5-3, serve as an experiential example of the important design factors to consider when making a game for supporting creativity in motivated learning, which emerged as a refinement of the CGBL framework.

After a successful cycle of formative evaluations, when a prototype is robust enough, a Designer can proceed to analyse the CGBL aesthetics and creative learning outcomes in relation to the positive CSG outcome. In Chapter 6, I report on the summative evaluation of *Hazel Court v3.0* CSG.

<i>G1</i>	The settings of the CGBL mechanics instantiation need to be discovered and iteratively adjusted by a Designer in a series of formative evaluations with the Players, from the concept study, to the physical and digital prototyping. Using Players' feedback to inform the prototypes, will lead to a decrease in the level of abstraction of the CGBL mechanics' specification, and an increase in the level of robustness of the prototype.
<i>G2</i>	Depending on the Players' feedback, the CGBL mechanics can be designed to be more or less activated in the CGBL dynamics than proposed by the CGBL framework.
<i>G3</i>	A Designer should remain flexible during the iterative playcentric design process, be ready to make trade-offs when balancing the CGBL mechanics and dynamics, continuously learn from the data at hand, and systematically project that knowledge to the CGBL mechanics re-design in the next iteration.
<i>G4</i>	Evaluation of the dimensions of a good CSG experience in each design iteration, and in particular in the early iterations, inform the Designer of what works well and what needs improvement in the next mechanics re-design, and help to keep track of the overall progress towards the goal of positive CSG outcome. This task can be done using methods that include debrief interviews, user observations, and debrief questionnaires.
<i>G5</i>	When there is sufficient evidence of the dimensions of the good CSG experience from the prototype playtests, the Designer should then evaluate the CGBL aesthetics and creative learning outcomes in relation to the CGBL mechanics. This task can be done using methods such as debrief interviews, user observation, follow-up questionnaires, and diary study.
<i>G6</i>	The abstraction level in the implementation of the CGBL dynamics can gradually decrease as the prototyping process advances, from the 3-phased creative process model towards the 8-phased creative process model.
<i>G7</i>	The refinement of the CGBL dynamics, from the 3-phased to the 8-phased creative process model, depends on the evolution of the CGBL mechanics in the iterative playcentric design process. Some factors worth considering before the refinement is made are: the creativity techniques that were most compatible with the user group; the appropriate level of the concept's semantic distance from the domain; the choice and style of facilitation; designer-generated resources that supported the creative process; the usability of the technology supporting the creative process; and the timing involved in each stage of the creative process.
<i>G8</i>	Incubation is a stage of the CGBL dynamics that can be omitted in CSG design, without major consequences for the positive CSG outcome.
<i>G9</i>	A Designer should consider implementing team-player mode, rather than single-player mode or between-player competition, and adjust the instantiation of the CGBL components in the CSG design accordingly.
<i>G10</i>	A Designer should consider implementing some form of creative process facilitation in the CGBL mechanics and designer-generated resources, in order to increase the prospects of a positive CSG outcome.

Figure 5-3: The methodological guidelines (*G1-G10*) for the CGBL framework instantiation, which present a refinement of the CGBL framework, inferred from the conducted formative evaluations reported in Chapter 4.

Chapter 6 – Summative evaluation

6.1 Introduction

This chapter reports on the summative evaluation of *Hazel Court v3.0*. The main objective of this evaluation was to use the prototype to test the components of the CGBL framework that describe the creative learning outcomes of the CSG, and the aesthetics one experiences during the dynamics. The hypothesis was that, by the framework's definition (see Section 3.3), the elements from these two CGBL components, if at least partially experienced or exhibited by players during the dynamics, together produce a positive CSG outcome (Figure 6-1).

Objective	Question	Outcome
OBJ3: Evaluate the CGBL framework with playtesting of the final CSG prototype in an empirical study of the CGBL aesthetics and creative learning outcomes.	RQ3: Does the final CSG prototype induce a positive CSG outcome, as defined by the CGBL framework?	Outcome: The partial CGBL framework validation.

Figure 6-1: The partial CGBL framework validation was the third objective of this research, which the work described in this chapter addresses by investigating *RQ3*.

The chapter begins by describing the research sub-questions that this study addressed and the relevant approach that was undertaken, in the *Method* section. The *Results* section reports how the outcome of the partial validation of the CGBL framework was achieved, i.e. a positive CSG outcome was determined. In the concluding section, the results are discussed in the light of the set objectives, hypothesis and identified threats to validity.

6.2 Method

The evaluation took place at seven residential homes that were members of either the Registered Nursing Home Association or My Home Life, two organizations that I collaborated with in Greater London. Each evaluation session was scheduled to take part in an irregular training period in each home, and involved three or four care professionals. Each home was offered the training for free, in return for the use of the evaluation data from it. A total of 12 separate sessions were scheduled to place between 26th February and 8th May 2014 (months M29-M32 of the doctoral project). The seven residential homes varied in size, from 26 to 150 beds, and housed residents with a wide range of physical and cognitive impairments. They were considered to be typical of residential homes in the United Kingdom.

Care professionals from the homes played the *Hazel Court v3.0* CSG. Each session took place in a quiet room or space in the residential home. The same facilitator, myself, led all of the *Hazel Court v3.0* CSG training workshop sessions based on pre-scripted routines, to reduce the influence of facilitator behaviour on results. Five playtesting sessions were also accompanied by Simone Mora, who had developed the *Hazel Court v3.0* hardware and contributed to the design of its physical components, and was an observer in case of hardware troubleshooting. The mapping to the CGBL dynamics is shown in Table 6-1.

The CGBL dynamics	Exposure group activities
<i>Find and formulate the problem</i>	The game introduces Mr & Mrs Black and the other characters in Hazel Court, and then poses a challenge for carer detectives – to investigate why the Blacks have been acting unusually lately. The pawn, when placed on the start position – Hall, on the board, emits this information in audio (i.e. recorded voice) and visual form (i.e. Hazel Court avatar) triggered by the NFC tag. Game master helps participants to get immersed in the story. This lasts about 5-10 minutes.
<i>Acquire knowledge relevant to the problem</i>	The board is explored with the pawn – three board rooms are visited – game branching depending on participants' choices. Each room contains clues.
<i>Gather a broad range of potentially related information</i>	The clues are of various types: audio/visual (meeting characters who share information, via the pawn); visual/text (the magnifying glass is used for exploration, and it flashes and vibrates when the clue is found in a room on the board, and it activates the clue printer box that gives a textual association). Information gathering on the board lasts about 20-25 minutes.
<i>Take time off for incubation</i>	The treasure hunt is initiated for more physical clues in the physical room. This activity gives the unconscious mind time to process the apparently unrelated information and make surprising connections. These objects are also covered with NFC tags and explored with the magnifying glass. This takes about 5-10 minutes.
<i>Generate a large variety of ideas</i>	Game master facilitates the association generation. Participants are instructed to individually take one clue at the time, of their choice, and write down associations on post-its, in large quantity and quickly. They put these in the communal space in the middle of the table, and when they are finished, they are encouraged to look at what the others wrote and discuss. This takes about 5-10 minutes.
<i>Combine ideas in unexpected ways</i>	The participants are guided by the game master to combine the associations from the previous step into headlined ideas that they brainstorm individually. The process is explained via brainstorming rules and headlining examples to get them started, that are put up on the wall in the room. This takes about 5-10 minutes. Participants are still surrounded by all the various clues, for inspiration.
<i>Select the best ideas, applying the relevant criteria</i>	Creativity triggers (visual/text) on the My Home Life themes (i.e. Maintaining identity, Sharing decision-making, and Community building) are used as relevant criteria for idea selection, and they are put up on the wall in the room. Participants are invited to sort their ideas into three categories, respectively. Participants are invited to elaborate and discuss their ideas. They choose the category they think contains the most intriguing ideas, and that set is then suggested to be used in the final idea development stage.
<i>Externalize the idea using materials and representations</i>	Participants are asked to come up as a team with only 1 idea for a person-centred engagement with the Blacks, based on the artefacts they generated in the game. They are instructed to present it in a Who-When-Where-How chart and a representative group chooses to orally elaborate and summarize it.

Table 6-1: The instantiation of the CGBL dynamics by the dynamics implemented in the *Hazel Court v3.0*.

The care professionals played the *Hazel Court v3.0* CSG under the direction of the game master (i.e. facilitator). During the

convergent thinking stages, the facilitator demonstrated each creativity technique to the care professionals, and then maintained a creative climate by monitoring for behaviour that might challenge it. At the end of each evaluation, one care professional was asked to present the new care activity verbally to the facilitator, and then all care professionals individually completed an open-ended questionnaire about the experience. The final idea that the participants generated was to be described using a *Who-when-where-how* chart, a form of graphic organizer with which to depict a story or event in a simple and visual way.

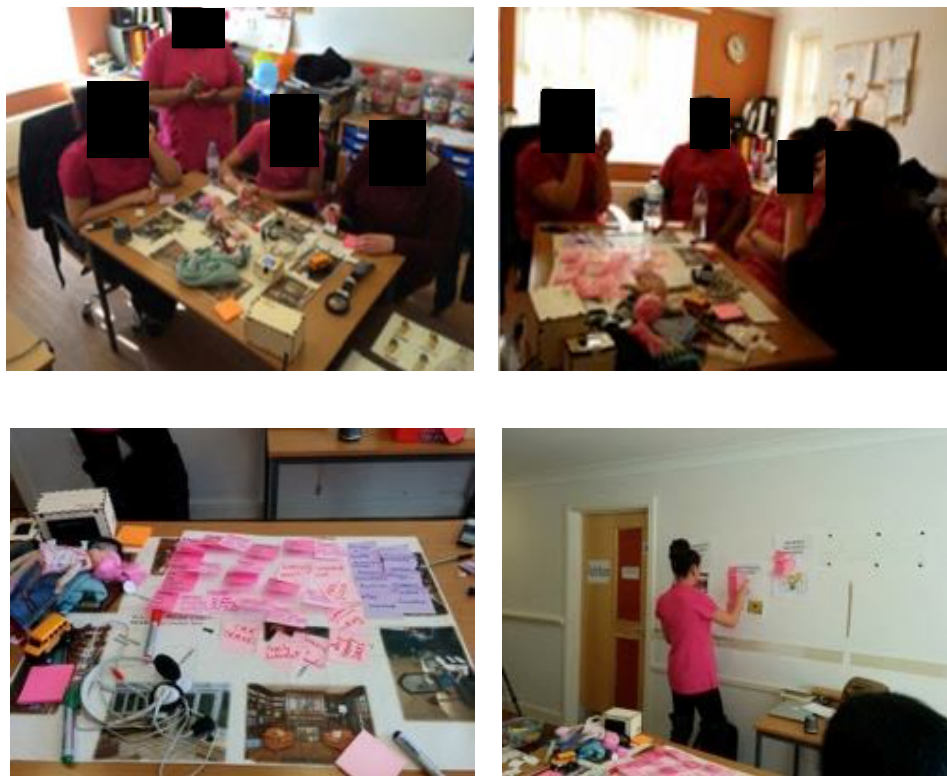


Figure 6-2: Photos from *Hazel Court v3.0* playtesting with care team-A, showing excerpts from the idea generation (top) and selection (bottom) phases of the dynamics.

The session-by-session analysis of compiled observations summaries of game play were triangulated with questionnaire responses to provide a first answer to an exploratory research sub-question:

- *RSQ1*: Did care professionals exhibit the aesthetics and engagement in the dynamics that were defined by the CGBL framework?

Moreover, to investigate longer-term impacts on care work generated from playing the *Hazel Court v3.0* CSG (Figure 6-3), an open questionnaire was sent to the managers of the participating residential homes three months after their session took place. The questions collected qualitative evidence of care changes that could be associated with playing the game that was used to answer a second exploratory research sub-question:

- *RSQ2*: Did care professionals who played the *Hazel Court v3.0* CSG change their care behaviours to deliver more person-centred care to their residents?

All new care activities generated from each *Hazel Court* game play and training workshop were rated independently by six experts in dementia care, in order to compare the activities generated from the game plays and workshops. Each expert rated each care activity for its creativity and its fit to the needs of the individuals. Novelty and usefulness are established measures that have been applied to rate creative outcomes (see Section 2.2.1.2), and the degree to which each care activity was individualized to the Blacks provided a direct rating of person-

centred care. To enable unbiased rating by the experts, each activity was described in written summaries of about 100 words from the audio-recorded verbal presentations of each care activity by the care professional at the end of each session. Therefore, during the rating task, each expert individually completed a questionnaire composed of the randomly-ordered written summaries and three Likert 1-5 scales to rate: the *novelty* of each, the *usefulness* of each, and the *degree to which delivered care was individualized to the Blacks*. The experts were an academic who leads research in older-adult nursing, a care practice development consultant, a lead nurse, and three managers in residential homes in which the evaluations took place. All six experts independently completed the questionnaire, and the ratings were used to answer the following additional research sub-question:

- *RSQ3*: Did the care professionals who played the *Hazel Court* serious game generate care activities that care experts considered creative in the sector?

6.3 Results

A total of eight of the 12 scheduled sessions took place. The other four sessions were cancelled due to the lack of availability of care professionals at the agreed times because the immediate care of residents took priority – a recurring challenge to research in such environments. Each of the eight sessions was delivered to three or four care professionals from the same residential home. Of the 31 professionals, 18 were carers who delivered daily care to their residents, two were nurses with medical training, nine were

activity organizers responsible for planning resident involvement in home activities, and two were managers in the residential homes. Some of the care professionals had as little as three months care experience, while some of the managers had over 15 years of work experience in the sector. All game plays of the *Hazel Court* CSG and training workshops were successfully completed, and each generated a new care activity that was reported back to the facilitator.

6.3.1 The CGBL aesthetics and engagement in the CGBL dynamics in *Hazel Court v3.0*

The care professionals who played the *Hazel Court* serious game played both divergent and convergent thinking levels of the CGBL dynamics. There were no major technology failures, and the care professionals experienced no serious usability problems with the prototype. Therefore, to establish a first answer to research sub-question RSQ1, the responses to the open-ended questionnaire completed by each care professional at the end of each evaluation were reviewed to provide first evidence about the *Hazel Court* serious game play experience.

The detective theme that underpinned the game's design (see Section 4.2) appeared to engage care professionals: "*detective part I like and enjoy most. It was so fun because it was something new*" (P2S7), "*I felt intrigued, enabled, and satisfied*" (P1S1), and led to idea generation: "*very fun - the game and gaining more ideas from it - very helpful*" (P4S2). The game's *Feedback* mechanism appear to have led to teamwork throughout the dynamics: "*was good to*

think of ways of communicating and producing activities for daily life in a care home” (P2S5), *“easier as a team, listen to others’ ideas - no wrong answers”* (P1S4), *“it is more easy to come up with decision if there are more ideas. Team work makes the dream work!”* (P2S8) and *“it was quite interesting and applicable to residents, we learned a lot from each other, by sharing different views and ideas”* (P3S7). There was also some exhibited evidence of training for person-centred care, for example: *“I got to know the person as individual and their preferences, found that to be creative and valuable”* (P1S6). However, observations revealed that different care professionals played the game differently, so each exposure condition session was analyzed separately.

6.3.1.1 Care team-A

Care team-A engaged in all five of the implemented mechanics to generate new ideas during the creative workshop, for example to: *“play them their favorite song during dinner”*. Its care professionals exhibited emotions such as *joy, surprise* and *trust*, especially during the play phase, which was observed from their behavior and indicated by their feedback at the end of the session. The new care activity was generated primarily from a clue about the seaside discovered from the board game during the play phase to take the Blacks and their friends on an engaging trip to the seaside. After the game, one of the care professionals reported: *“We really had to think. It was exciting for me, even though I’ve done lots of training around dementia, and this took off to a whole new level, because it had a feel of mystery to it... you made us do a practical thing, it was so exciting”* (P1S1). Another reported: *“I*

was more and more intrigued about the residents and what is happening to them, it really captures your mind, fantastic” (P3S1).



Figure 6-3: Photo from the playtest, showing care team-A in their training environment in the care home, and the chart they made to externalise their final idea.

The new care activity that this team generated was about the reunion at the seaside: *We are going to seafront in Southend with Mr & Mrs Black, because we’ve found some of their friends who moved outside of London and live in Southend now. We’re going to organise them a reunion and create new memories for them. When one is taken to the seaside, they usually love picking up the stones and shells – they might use to collect them. They can go back in their mind and feel that security, touch and smells. We’re going in July or August, bringing along their close friends, family, and pets.*

6.3.1.2 Care team-B

Care team-B also used all of the implemented CGBL mechanics using the game resources (Figure 6-4) to generate a new care activity to replicate a seaside visit based on the same board game

clue, and the four activity coordinators in the team exhibited desirable aesthetics such as *anticipation*, *joy* and *surprise* when using the board and treasure hunt during divergent thinking stages of the dynamics, as indicated by their feedback. However, their emotions became more serious and they exhibited less flow in the convergent thinking stages, suggesting that tighter integration of the game play and the facilitated creative thinking might be needed to encourage the desirable aesthetics to be experienced throughout the game.



Figure 6-4: Photo from a *Hazel Court v3.0* playtest, showing: i) left, care team-B of care staff players with the game resources: board, clue printer box, pawn, magnifying glass; ii) right, the same group during Selection stage with creativity triggers.

The new care activity that this team generated was about a garden party with a beach theme: *In the summer, e.g. June, we would recreate the seaside in a garden of the care home for Mr and Mrs Black and other residents. We would use easy-to-find props such as sand, water, deck chairs, bucket, spades, fans, shawls, hats and sunglasses, and play appropriate music, to immerse in*

the theme. We would make our garden party be a beach party for everyone to enjoy.

6.3.1.3 Care team-D

Members of care team-D (Figure 6-5) also exhibited evidence of emotion change between the game play and creative thinking phases – they appeared suspicious of the game and resisted the change to creative thinking, their anticipation decreased, and in contrast to team-B, they exhibited little *joy*, *surprise* and *anticipation*. The restricted training space, in a small poorly lit room in the home's attic might have influenced these emotions. However, the carers did use the game resources to generate a new care activity previously discussed but never implemented in their home.



Figure 6-5: The restricted training space with care team-D was a former private resident room in the attic.

The new care activity that this team generated was about making a wedding memory board: *We would ask the family of Mr & Mrs Black to bring us their wedding photos and put them on a big board. The board could be physical, or digital, displayed on TV. We would ask the residents about their wedding day, the music*

that was played, what clothes they wore, what her wedding dress looked like etc. Maybe make a wedding cake too which they could cut, and make a party in a lounge for everyone to join in.

6.3.1.4 Care team-H



Figure 6-6: Photo from the playtest, showing board exploration and clue examination, with the CGBL mechanics supporting the engagement of the players in care team-H.

Care team-H exhibited increasing confidence and flow during the game – its members reported that the board exploration and narrative setting was most suitable to support creative work (Figure 6-6): *“Detective part of the game I like and enjoy most. It was so fun because it was something new”* (P2S7). It generated a care activity to take residents to take a trip outside the care home to visit their family homes and members: *We would like to organise for the residents to take a trip outside the care home and visit their family home. This would be done in coordination with their family members, who would collect them from Hazel Court care home. The best time would be school or bank holiday, so that people have more free time in general. We could organise a visit to*

a public garden for the residents who don't have family or their family members are unavailable.

6.3.1.5 Care team-E

Care team-E created a new care activity that used digital technologies. It (Figure 6-7) was composed of younger care professionals and exhibited all of the CGBL aesthetics throughout the generation of a proposal for residents to use Internet technologies to remain in contact with friends and family, which it was motivated to apply in practice: *“The outcome of the process is something I'd love to recommend to my management”* (P3S5).



Figure 6-7: Photos from the playtest: left - care team-E playing Hazel Court v3.0; right - Who-where-when-how chart with attached clues that inspired the final idea.

The detailed new care activity this team generated was: *To maintain Blacks' quality of life, we intend to help them stay in touch with family and friends using the Internet. Care assistant should be there to help set up the device. It can take place in a room that is private and quite, like 1950s room, or the sensory*

room. Best times for this activity would be weekends and evenings, because then their family/friends are more likely to have free time. We would make appointments and obtain internet access, devices and make a Skype account for the residents.

6.3.1.6 Care team-F

Care team-F focused also on the application of technology in the residents' activities. This team was from a home that had adopted mobile tablet use in care work, and generated a plan for residents to use the Internet for a wider range of purposes such as shopping and dressing to go out based on weather forecasts. The carers exhibited evidence of the *trust* aesthetic and the collaboration dynamic throughout, as observed and concluded from the video analysis and provided feedback that contained many instances of collaboration and reflective discussion.

The new care activity this team generated was: *We want to do two things we haven't done in this care home before, which is skypeing using the Internet, and taking the residents out to shopping. When requested by Mr and Mrs Black, we could organise assistance for them to get connected on the computer and talk to their family and friends in the lounge or their room, as well as to go out shopping, dressed according to the weather.*

6.3.1.7 Care team-C

In contrast, care team-C engaged with all five game mechanics and exhibited *trust* but not other aesthetics such as *joy* and

surprise, even though the game was recognized as unique: “We’ve never done such training before. Technology is brilliant...” (P1S3). The new care activity to create a family tree for the Blacks was generated from creativity triggers rather than clues discovered with the board game or treasure hunt: We do have care plans but we don’t have family trees – meaning that only resident’s life history is available, and not their family history. When the family comes to visit, care staff could help them make a family tree together with the residents. It would allow us get to know them better, but also keep their memories recorded. We recently started doing memory boxes, and this family tree could be part of it. It could prolong their ability to maintain identity and it could serve as their reflection trigger.

6.3.1.8 Care team-G

Care team-G also used all five game mechanics, exhibited considerable evidence of trust, collaborated throughout, and generated a care activity to take residents out for coffee and trips to the park on special occasions, reporting: *“simple, obvious and useful such as going out of the care home for coffee they haven’t thought of before” (P1S7), indicating this an important creative outcome for the team. The new care activity this team generated was about having a Sunday lunch outside the care home: We would like to take Mr and Mrs Black, Mr Green and any other interested residents for a lunch at a local café or near park, outside of the care home. That is something we never tried before, and we think they would enjoy the change. We could do it on any Sunday or anniversary. It would require consideration of transport*

limitations, consent from relatives, booking the venue and escort staff support. Simple and effective, but we haven't thought of it before.



Figure 6-8: Photo from the playtest, showing care team-G in the last two stages of the CGBL dynamics, selection and externalization of the final idea.

6.3.1.9 Conclusions

These results from analysis of the individual game play sessions revealed that, although the five game mechanics were used and their implementation was reliable, the teams exhibited some but not all of the dynamics in the framework, and their emotions varied by team, suggesting the influence of external factors such as the game play space and levels of experience of the carers.

Most new care activities could be traced to uses of one or more of the game mechanics.

6.3.2 Domain-specific learning and motivational benefits

The Microsoft Product Desirability test results (see Section 4.5.2.2 for the method description) show that the participants found the training to be mostly *Helpful*, *Productive*, *Understandable*, *Inspiring* and *Easy to learn* (Figure 6-8), which was all contributing evidence to the achievement of domain-specific motivational benefits, defined in the CGBL framework. There was also an increase in the perceived *Engagement*, as the groups found it to be one of the key features, and it was not as expressed in the playtesting of *Hazel Court v2.1* (see Section 4.5.3.2). The importance of engagement in serious games is discussed in Section 2.1.1.1.

Hazel Court v3.0 exposure groups 8, N=31	
Appealing	4
Boring	0
Confusing	2
Difficult to use	0
Dynamic	1
Easy to learn	10
Empowering	2
Engaging	18
Familiar	2
Friendly	8
Helpful	21
Ineffective	0
Inspiring	10
Intimidating	0
Intuitive	0
Inviting	2
Naïve	0
Novel	0
Overwhelming	0
Predictable	1
Productive	17
Professional	8
Safe	2
Satisfying	6
Straightforward	5
Supportive	6
Too technical	2
Unattractive	0
Understandable	11
Valuable	8

Figure 6-9: Product Desirability test results between the conditions, showing a considerable rise in engagement among exposure groups. Attribute colours indicate an emotional disposition: blue - negative, pale purple - neutral, dark purple - positive; numbers colours gradients signalise three frequency levels - darkest are the highest (<15), lightest are the lowest (>10).

Furthermore, to answer research sub-question RSQ2, responses to the questionnaire received from four of the seven residential homes revealed early evidence for care practice changes in all homes. Other three managers did not respond to my email invitations to participate in the follow-up questionnaire, possibly due to time pause in cooperation. One manager reported that s/he *“thinks more about residents’ personal belongings and what they mean to them”* (P2), while a second claimed that *“Since the training [.....] the staff team have been more dementia aware in their approach towards the customers and focusing on individual personal, cultural and social needs. Through the provision of activities, the staff team have person centred”* (P4). In response to a question about the motivation of carers, one manager reported that *“the staff team reported that they were more motivated as to focusing on the customers as unique individuals”* (P4), while another claimed that playing the serious game had *“enabled me to look more at information, e.g. photos, things telling me of life, background of residents”* (P2). Three of the managers claimed that teamwork was enhanced: *“improved working as a team”* (P3), and *“the staff team reported that they were more focused on treating the customers as unique individuals. The senior team have noted and remarked upon the benefits of the training on the care staffs’ attitude and approach towards the older people”* (P4), while the fourth stated that *“not enough staff able to take part, better if everyone could have tried the experience”* (P2). No negative comments were reported. This qualitative evidence indicates some change to more collaborative and person-centred care from playing the serious game, although little direct evidence of uptake of new investigative and creative thinking strategies.

Data from the post-evaluation questionnaire (Appendix D-2), returned by email from two of the participating care homes (Samples 1-4), revealed a perceived general improvement in motivation, teamwork and person-centred care practice after the exposure condition training (Table 6-2).

Sample	What changed in your practice after the Hazel Court training?	What effect did the Hazel Court training have on your work motivation?	What effect did the Hazel Court training have on your work in a team?
1	I am working better as a part of a team.	I have always been motivated.	Teamwork has improved.
2	I think more about residents' personal belongings and what they mean to them.	Very good.	Not enough staff able to take part, better if everyone could have tried the experience.
3	Improved working as a team.	Enabled me to look more at information, e.g. photos, things telling me of life, background of residents.	Positive.
4	Since the training at Bluegrove in April 2014, the staff team have been more dementia aware in their approach towards the customers and focusing on individual personal, cultural and social needs. Through the provision of activities, the staff team have person centred.	The staff team reported that they were more motivated as to focusing on the customers as unique individuals.	The staff team reported that they were more focused on treating the customers as unique individuals. The senior team have noted and remarked upon the benefits of the training on the care staffs' attitude and approach towards the older people.

Table 6-2: Quoted replies from the participants, collected via the follow-up questionnaire.

6.3.3 Creative outcomes

To seek an answer to research sub-question RSQ3, the dementia care experts rated the written summaries of the eight care activities as shown in Table 6-3. All summaries are disclosed in Appendix D-1, and quoted per team in Section 6.3.

Overall, six experts rated the care activities generated with the *Hazel Court v3.0* serious game in the following way (on the Likert scale 1-5, from low to high): i) *novelty* mean rating scores were 3.33 to 2.93; ii) *usefulness* mean rating scores were 3.46 to 3.57; iii) *person-centredness* mean rating scores were 4.18 to 4.30.

Condition	Care team identifier	Av. novelty rating	Av. usefulness rating	Av. person-centredness rating
Hazel Court CSG	A	3.67	3.33	4.33
	B	3.50	3.67	3.83
	C	2.67	3.33	4.50
	D	3.67	3.50	4.17
	E	3.50	3.50	4.67
	F	3.67	3.67	3.67
	G	2.67	3.50	4.17
	H	3.33	3.17	4.17

Table 6-3: Average expert novelty, usefulness and person-centred ratings per care activity generated by the care teams.

Table 6-3 shows that two activities from playing *Hazel Court v3.0* were rated as less novel than other *Hazel Court v3.0* activities. The session-by-session observations reported above revealed that care-team-G did generate a care activity that was novel, useful and hence creative to the team but not the experts, while care team-C did not use the discovered information from the board game and treasure hunt game mechanics to generate the new care activity, and this might have limited their creative potential.

On average (Table 6-4), the results from the eight playtesting sessions show that participants generated creative (i.e. novel and useful) and very person-centred solutions, as determined by domain experts.

Condition Criteria	Expert ratings	
	Mean	St. dev.
C1	3.333	0.427
C2	3.458	0.173
C3	4.187	0.327

Table 6-4: Descriptive statistics showing average mean values and standard deviation in expert scoring on three criteria: novelty (C1), usefulness (C2) and person-centredness (C3) of eight samples from groups exposed to *Hazel Court v3.0*.

6.3.4 Threats to validity

These results are subject to different threats to their validity. One threat to conclusion validity was the evaluation's artificial nature. In person-centred care, care professionals should always have prior knowledge of their residents, and the inability to enable this in the evaluation provides one possible explanation for no increase in the expert ratings of person-centred care from playing the game.

Two internal validity threats that affected the independent variables were variations in the levels of expertise of the care professionals, and experimenter bias. Experimenter bias was a clear possible influence on both the facilitation and writing the 100-word summaries of the care activities, however it was sought to mitigate it by scripting the facilitator role, and having care professionals to summarize care activities beforehand.

This evaluation also limits the claims to generalize from just eight sessions in seven residential homes. However, the results do

provide first evidence to support the CGBL framework's effects on participants, in terms of aesthetics, domain-specific learning and motivational benefits and creative outcomes.

6.4 Conclusions

Evaluation results revealed that, although the CGBL game mechanics and resources were used and their implementation was reliable, the teams exhibited some but not all dynamics in the framework, and their emotions varied by team, suggesting the influence of other factors (RSQ1). Moreover, the managers of over half of these care professionals reported plans to change some care practices to become more person-centred and collaborative as a result (RSQ2). The expert analysis of the care activities generated from the creative serious game revealed that the game did not result in the generation of care activities that were creative and person-centred (RSQ3). Factors such as experience and use of the game mechanics and resources impacted on the novelty and usefulness of generated care activities. Overall, the evaluation result indicates that the game has the potential to deliver effective training for inexperienced carers, and its detective board game, treasure hunt and creative workshop resources and mechanics that operate them can contribute to both short- and longer-term changes in care activities that do not detract from the usefulness of the care delivery. More generally, the result provides evidence for the effective use of the implemented mechanics that led to carers exhibiting at least some of the desirable aesthetics (i.e. *joy, anticipation, trust, surprise*), however not all of the desirable dynamics were exhibited during

the game plays. Other contextual factors appear to influence carer behaviour during game play, and need to be incorporated into future versions of the framework.

Returning to the research question *RQ3* quoted at the beginning of the chapter, these findings supported partial validation of the CGBL framework (i.e. the proposed effect in aesthetics, domain-specific motivational benefits and immediate creative learning outcomes), and evidence indicate some positive CSG outcome in all *Hazel Court v3.0* exposure condition sessions. Carer use of the detective board game, treasure hunt and creative workshop game resources were associated with divergent thinking dynamics stages, and aesthetics such as *joy* and *surprise* that the carers exhibited and reported. More controlled studies are needed with discrete uses of different implementations of the CGBL game mechanics and detective board game, treasure hunt and creative workshop game resources to support the CGBL dynamics, and intended positive CSG outcome.

Chapter 7 – Discussion

7.1 Summary of the research outcomes

The existing knowledge gap between the scientific fields of creativity and serious games technologies (i.e. how to create more playfully and to play more creatively) was the research driver behind this doctoral project. The opportunities were defined and discussed in Sections 1.2, 2.1, and 2.2 in the light of state-of-the-art related work in both fields. My efforts towards bridging that knowledge gap focused on creativity support in games for motivated learning, and found their application as an educational resource in person-centred dementia care staff training. The rationale for this particular setting was explained in Section 2.3.2, where I analysed the eligibility of dementia care staff as a CGBL user group.

In that motivational context, there were three main outcomes of the project that are my original contributions to the body of knowledge, and mark the achievement of the three research objectives I had, reported in Section 1.4. These outcomes are summarised in turn:

1. **The Creative Game-based Learning (CGBL) framework** (see Chapter 3): I propose a novel theoretical stance on the explicit integration of creative problem solving support within serious games for motivated learning. Grounding my research in related models and frameworks, I synthesised the results from the scientific fields of creativity and serious games into a new understanding, and as a result extended the existing

knowledge with my creative serious games (CSG) design recommendations in the proposed CGBL framework. These game prototypes are, simultaneously, envisioned to be a new type of SGs, and a new type of CPS facilitation. I defined and deconstructed the components of a CSG (i.e. the CGBL mechanics, the CGBL dynamics, the CGBL aesthetics and the creative learning outcomes). The descriptive nature of the CGBL framework required a visual complement that adequately depicted the numerous dynamic dependencies between the individual components of the mechanics, dynamics, aesthetics and creative learning outcomes, as well as the different perspectives of the stakeholders involved (i.e. designers and players). As a consequence, I explored and theoretically described the relationship between creativity and gameplay for motivated learning by proposing a domain-independent framework for creative game-based learning (CGBL) [OBJ1];

2. **Design and development of CSG prototypes that aimed to instantiate the CGBL framework in the application domain of person-centred dementia care staff training** (see Chapter 4): I adapted an iterative playcentric game design process [62] to CSG design and development. I undertook four formative evaluations that involved diverse qualitative research methods, the results from which led to the consecutive development of three intermediate CSG prototype versions (i.e. *Hazel Court v1.0*, *v2.0* & *v2.1*). Over the course of the process, I ran a total of 16 formative evaluation workshops in which 54

care staff members in four care homes provided direct (attitudinal) or indirect (behavioural) feedback on the designs. The evaluations resulted in a better understanding of domain users' experience in the CGBL context, and a set of design recommendations about the prototype's mechanics and dynamics (see the summary in Section 4.7) which were integrated into the final prototype, *Hazel Court v3.0*. As a consequence, I designed several customized game prototypes with integrated creativity support that instantiate the CGBL framework in the application domain of dementia care, and learned valuable lessons on how to instantiate the CGBL framework for a particular domain [OBJ2];

3. **Partial validation of the CGBL framework** (see Chapter 6): The summative evaluation undertaken in the field with *Hazel Court v3.0* confirmed the overall positive CSG outcome described by the CGBL framework, which was at least one aesthetics and one creative learning outcome were reached in each of the playtests - otherwise the validation would have been considered unsuccessful. In total, the evaluation involved 31 care professionals in eight workshops in seven care homes. Domain users often experienced the intended CGBL aesthetics and achieved some of the anticipated creative learning outcomes. The users also created ideas that were by a group of external domain experts on average considered novel, useful and person-centred, and the participants reported high level of engagement. Some domain-specific motivational benefits were also discovered. Participants shared reflections on

their practice, and the managers of over half of these care professionals reported plans to change some care practices to become more person-centred and collaborative as a result. As a consequence, I succeeded in partially evaluating the CGBL framework with playtesting of the final CSG prototype in an empirical study of the CGBL aesthetics and creative learning outcomes [*OBJ3*], with an overall positive outcome.

This final chapter continues in four parts, in which I will:

1. Discuss the results of the project, in terms of the associated research questions;
2. Discuss the research contribution in the context of some of the most recent related work;
3. Present the opportunities for exploitation activities and future work;
4. Draw conclusions about the project contributions.

7.2 Discussion of the research outcomes

The following subsections will elaborate on the findings gathered in the investigation of my three research questions, which focused on studying and providing creativity supports in games for motivated learning.

7.2.1 Addressing RQ1

***What are the shared characteristics of creativity support
and good game design?***

The result of addressing RQ1 was to offer one theoretical description of the relation between creative problem solving and serious games, proposed in the form of the domain-independent Creative Game-based Learning framework (see Chapter 3). Determined shared characteristics of creativity support and good game design [171] were:

- Challenge;
- Freedom;
- Idea-support;
- Trust & safety;
- Humour & playfulness;
- Idea-time.

These characteristics were then implemented in the CGBL framework as dimensions of good CSG user experience. They were the foundation for the framework's main components, and my intention was that, in the context of the problem of connecting creativity support and good game design practice, the framework can be used by designers and researchers as a blueprint for:

- New guidelines on how to make CSGs that support creative learning through CPS (i.e. the *CGBL Mechanics*);
- Describing the creative process and outcomes of a CSG play session (i.e. the *CGBL Dynamics* and *creative learning outcomes*, respectively);

- Describing possible creative learning outcomes of playing a CSG (i.e. creative learning outcomes);
- Describing which emotional reactions (i.e. the *CGBL Aesthetics*) designers should target to induce in players as a result of a CSG play session, which would also positively influence the dynamics and the creative learning outcomes.

The CGBL framework is my response to the challenge of theoretically bridging the gap between the fields of creativity and serious games. The identified shared characteristics between creativity support and good game design serve as intersection design themes that designers and researchers should consider when thinking of creative learning, and more generally creative problem solving, in a gamified context. I argued that targeting the development of these shared characteristics as dimensions of user experience within a CSG, and following other CGBL framework guidelines (see Section 3.3), should positively influence transformation of the organisational climate towards a more playful and creative one.

However, the addressed synergy between the fields is complex and there are several limitations to recognise, and open questions to acknowledge. To this end, the framework only provides a preliminary contribution, albeit a fundamental one. Firstly, the framework is elaborated in terms of the dependencies between the CGBL dynamics and aesthetics, but remains relatively restrained in terms of addressing and refining *mechanics-resources* dependencies, as well as the *mechanics-creative learning outcomes*, and *mechanics-aesthetics* dependencies, which I think would be interesting directions to theroretically explore further.

Next, the framework describes the designer-generated, player-generated and game-generated resources. It is important to consider the role of technology in this context. The literature review indicated (see Section 2.1) that a digitally supported CSG would be an effective solution; however, the framework did not differentiate between the possible designer-generated and game-generated resources (i.e. imposed by the Designer versus co-created by the Player). Also, the existence and nature of the dependencies between the dimensions of good CSG UX as Designer's goals on one side, and the CGBL aesthetics and creative learning outcomes as Player's goals on the other, still needs to be tested and explored further.

Furthermore, due to its domain-independent focus, the framework itself is abstract in terms of implementation guidance. The theory presented here does not quantify or constrain the components to implement, the dependencies or actors' goal achievement in any way. This limitation has an impact on any attempt to apply evaluation metrics in CSG evaluations. Therefore, designers and researchers attempting to instantiate the framework should undertake a set of formative evaluations to identify the most appropriate CSG design settings, and corresponding CGBL framework components instantiation that are relevant to their domain. I would suggest applying an iterative user-centred approach, reported in this research. There is an opportunity here for further optimisation and refinement of the methodology of instantiation of the framework, as exemplified by these formative evaluations, that can be addressed in future work.

In conclusion, six shared between the fields characteristics were identified from the literature review and integrated into a theoretical framework proposal that employed and extended those findings. Emphasising the shared characteristics, and giving them priority over the ones that are not shared, thematically guides CSG design. Future research that will manipulate the instantiation values of the framework components can inspire many research questions that would aim to refine and validate the framework's recommendations.

7.2.2 Addressing RQ2

Which game mechanics, game environment, player mode, artefacts and creativity techniques are the most appropriate to employ in a creative serious game (CSG) instantiating CGBL framework in dementia care training domain, in terms of players' reactions to particular design choices?

The game mechanics (*Resource management, Collecting, Customisation, Variable challenge and Feedback*) and creative process dynamics presented in the CGBL framework have been initially adapted from findings from the literature review (see Section 2.1 and 2.2, respectively). In response to RQ2, their functioning was explored through the formative evaluations of the CSG prototypes that aimed to instantiate the framework for dementia care staff training. The concrete instantiation of the game mechanics, game environment, player mode, artefacts and creativity techniques implemented in the prototypes were adapted

to the needs of the users (i.e. care staff), which were analysed theoretically in Section 2.3, and empirically via user feedback and observations in four formative evaluations: the concept study, physical prototyping study (*Hazel Court v1.0*) [172], and two digital prototyping studies (*Hazel Court v2.0* & *Hazel Court v2.1*). Please see Sections 4.6 and 4.7 for the full report on these instantiation settings implemented in the final CSG prototype, referred to as *Hazel Court v3.0*. The final prototype employed the five CGBL mechanics in the setting of the CGBL dynamics. Within this prototype, dynamics were designed as a facilitated group creative process, consisting of eight stages, from problem understanding to externalisation of one final generated idea about person-centred dementia care. The concept of the detective theme to present challenges that were analogous to the challenges in everyday care work was identified, explored and expanded during the formative evaluations. Some of the game resources were iteratively adapted in contents towards semantically closer terms, and their representation evolved from paper-based towards digital properties (e.g. one game resource was first conveyed on paper cards, and then redesigned to being emitted in audio form from a digital pawn).

These settings supported the state-of-the-art concepts related to the technology, contents and outcomes identified in the literature review (see Section 2.1.2). The final prototype *Hazel Court v3.0* delivered: i) a more immersive, platform-independent technology solution – by its technology-supported board, components, artefacts and creativity facilitation; it shaped the fictitious world of *Hazel Court* in which the game takes place, and blended it with the physical world, allowing face-to-face group collaboration in the

creative process, where technology is assisting rather than leading the conversation; ii) more active player roles in co-creating game contents in dynamics – by its game mechanics that support the instructional content and play elements with the techniques of creative learning through CPS (see Section 2.2); iii) new customizable ways of generating and managing the variety of CSG outcomes – by not only testing and instructing, but by allowing players to create their own meanings through the experience, and even challenge the initial mechanics settings (e.g. by creating game resources).

7.2.3 Addressing RQ3

Does the final CSG prototype induce a positive CSG outcome, as defined by the CGBL framework?

In response to RQ3, the summative evaluation of the CGBL framework undertook a partial validation that evaluated some of the components related to a positive CSG outcome: the CGBL aesthetics, the immediate creative learning outcomes and the domain-specific motivational and learning benefits. The summative evaluation of *Hazel Court v3.0* confirmed that participants were engaged in the CGBL aesthetics: *joy*, *anticipation*, *trust* and *surprise*. The immediate emergent outcomes that the participants created (i.e. generated final ideas) in the groups exposed to the CSG were found by domain expert raters to be novel, useful and person-centred, with the ratings of person-centredness being the highest. However, for a more robust application of the quantitative method on the immediate creative

outcomes, a larger-scale study is needed. The debrief questionnaire results showed that the creativity support potentially becomes as a new variable in enhancing engagement within serious games for motivated learning. There were also positive qualitative reports from the follow-up investigation on the evolution of teamwork, motivation and person-centred practice among participants who were exposed to the CSG. These results showed that the CSG prototype was, overall, successful in providing a motivated learning experience, and that a positive CSG outcome was achieved in all sessions, by the CGBL framework definition. However, it is important to note that there were expected variations in the qualities and strength of the successful outcomes in the different groups due to their diverse professional and personal backgrounds, and many factors that were not in the scope of the study could have been of influence (e.g. participants personal background, habits, beliefs and values, education, language proficiency, previous gaming experience, previous creativity experience, the organisational climate, etc.). All of these factors need to be considered as variables in future studies.

There are other three important limitations concerning this summative evaluation:

- The validation of the framework was only partial, due to its complexity, and there were only a limited number of variables one can take into account when designing a study in the scope of a doctoral project;
- The framework was not validated in terms of the generalisability - it was tested only within one application

domain, again, due to constraints of resources in the scope of one doctoral project;

- The study did not compare the game with a baseline of traditional training methods, such as presentations, workshops, and individual homework;
- The facilitation of the sessions by a game-master is a variable that is clearly structured but not exactly defined (i.e. fully scripted), due to the nature of the task of facilitating a CSG experience that involves both creating and playing - two actions requiring constant real-time adaptation to the users. Therefore, the facilitation could be a source of bias if an attempt to replicate this study is made;
- Person-centred residential dementia care is a challenging domain for organising fieldwork - cancellations often occur due to nature of work as residents should always have priority, the internal IT infrastructure is often very weak, and there is a high variation in the quality of care, care staff profiles and in-house training support and facilities across the sector. I am grateful for having 11 care homes volunteering their time and resources for participation in response to my call, with over 100 professionals experiencing some version of *Hazel Court*. As previously stated, even with this number of participants, there were still limitations for the quantitative methods.

As a proof-of-concept, the summative evaluation of the outcomes defined by the CGBL framework, on the example of *Hazel Court v3.0*, provided positive results. New insights were made through session-by-session meta-transcript qualitative analysis of play

behaviour in interactions with a CSG as a novel form of game-based learning, and the impact of those interactions on the emotions of the participants (i.e. the CGBL aesthetics), their immediate creative learning outcomes, and domain-specific motivational and learning benefits that the experience provided.

7.3 Discussion of the research contributions

The results from the evaluations, and in particular the session timelines analysis, revealed that the prototypes in most playtest sessions supported all three improvisational aspects of play behaviour [161]: contingency, intersubjectivity and emergency (see Section 2.2.4). Therefore these CSG prototypes can be categorised as play interventions. However, given their educational aspect, the prototypes do not fit fully into the category of play interventions, but rather extend it. Such hybrid play intervention with the CGBL framework as its blueprint, add new insights to the ongoing debate on the nature of pretend play and creativity, and how to design play interventions to enhance creativity [162]. I argue that this is a valuable contribution to CPS support in adult, occupational, domain-specific setting. The CSGs offer an opportunity to facilitate CPS in a novel way, induced explicitly by designing appropriate serious game mechanics.

Facilitating group reflection using combined creativity techniques to manipulate diverse information, and CGBL mechanics to drive interest in an interactive experience, *Hazel Court v3.0* created unique opportunities for dementia care professionals to create

meaning (see Section 2.1) with creative learning benefits in a playful, flexible, and safe training environment. This resulted in a clearly acknowledged engagement level, and therefore suggests new opportunities for motivated learning experiences for professionals.

Recently, some other authors have also started to recognise the potential of utilising gamified creative processes for educational purposes. For example, Dodero et al. [50] studied gamified cooperative learning in the application domain of co-design, with reported success in fostering engagement. Kalinauskas [93] researched dependencies between Bartle's player types (see Chapter 2) and exhibited creative thinking in a game, with potential learning applications. There are also recent reports of explicit creativity support in the game design process. Fullerton [62], for example, collected experiences from many game designers on their creative process, from both industry and research backgrounds, and recommends explicit use of creativity techniques based on brainstorming for idea generation in the concept study design stage. Experimental games increasingly explore different ways of allowing and encouraging players to co-create within a game, as a way of investigating and innovating the storytelling process [76, 151]. This research also emphasises opportunities in pervasive technologies and embodied interaction for the purpose of creativity support in games for motivated learning. Similar technology was used in a serious game for crisis management [49], with successful reports in terms of engagement and initiated reflective learning. This pervasive game technology could help designers innovate the game resources, game mechanics instantiation and game dynamics, making a novel

impact on game aesthetics, such as *surprise* and *trust*, as the results of this research also suggest (see Section 2.1.2.3 and 4.6).

Finally, my project delivered a serious game with a social/emotional function that provides care staff, an often-neglected user group with creativity skills training, which they could use in their meetings to plan and deliver person-centred care. This practice, which I am trying to encourage by my research, could be extended to creative sessions in direct collaboration with residents focused on fostering person-centred activities, e.g. life-story explorations [97, 124].

7.4 Exploitation and future work

Proposing a theoretical framework that is domain-independent has its benefits in terms of exploitation potential, but also inherent risks. The level of abstraction is high, and successful instantiation relies on the designer’s individual understanding of both the chosen application domain and expertise with game design and creativity support to incorporate recommendations and balance the components adequately. Therefore, it is a challenge to think about ways to extend the CGBL framework so as to refine its recommendations even further, without committing to a particular application domain.

Arguing for a new type of SG could be a valuable addition to the state-of-the-art in serious game design. In order to investigate the generalisability of the framework, new instances of CSGs could be made for other application domains that require creative problem

solving in professional training, by instantiating the CGBL framework in those different domains, employing different variations of learning goals and user groups as an input. It would be interesting to compare the effectiveness of different creativity techniques within the same domain and the same baseline game resources and mechanics.

One of the main limitations of the current prototype design is its portability - the technology and physical components developed for the purposes of my studies are only proof-of-concept and not robust enough for wider exploitation. The two care home organisations that participated in the study expressed interest in incorporating *Hazel Court* into their in-house training, but for this reason, it was not possible. Patenting the technology and investing in production could overcome this limitation, and provide opportunities for larger-scale trials.

Furthermore, the prototypes were constrained by the need for human facilitation. This limitation could be addressed by the development of server applications and creation of in-depth manuals and creativity support training for in-house care staff trainers. More widely, it could be interesting to investigate whether more sophisticated computational creativity support could replace the human facilitation of convergent thinking in serious games for motivated learning in a more effective way. It is also challenging to optimise in real-time the game performance for other components, such as aesthetics, or the many trade-offs resulting from the inter-component dependencies [80] defined by the framework, as these effects can currently be detected only from the room climate, or users' verbal or non-verbal dynamically-

generated feedback. At the moment, the framework is too abstract for the fine tunings that the automation on that level would require.

Another interesting line of inquiry would be to conduct a longer study that would expose players to a CSG for an extended period of time that would allow the incubation stage of dynamics to take place, which my prototype didn't implement, due to limited exposure time with participants.

In this research, I provided the first example of the instantiation of the CGBL framework in the application domain of person-centred dementia care staff training. When seeking to explore other application domains for creativity support in games for motivated learning, other researchers and designers could benefit from the lessons learned in the adaptation of the iterative playcentric game design process [62] for the framework instantiation. Knowledge transfer could be especially valuable if parallels could be drawn between the requirements of the considered application domains.

The research questions my results have opened up provide a unifying point of interest in the context of the discussed interdisciplinary efforts: in creative problem solving support, serious games and person-centred dementia care. I argue that the CGBL framework and its instances have more unexploited potential: in providing a context for positive creative climate changes; using game as a training tool to open up innovative ways of communicating; and encouraging curiosity and appreciative enquiry.

7.5 Conclusions

One primary contribution of the project is a **theoretical framework** to inform the design of a new form of serious games that explicitly support players' creativity. This framework provides a first-cut description of how to design new technologies to deliver creativity training. Other researchers and designers are encouraged to adopt and validate it through development of their own creative serious games.

A second primary contribution is the **design and evaluation of creative serious game prototype consistent with the framework** to train carers to use more investigative and creative thinking in their work - a user group that is often neglected in dementia-related games research [122]. This project has revealed the potential of computer-supported creative serious games in person-centred residential care. Although sensor-based technologies have been successfully implemented in residential care settings [114], supporting forms of interaction that encourage carers to engage in the creative process in a gamified environment is a new development in residential care support. Finally, this research demonstrated that a serious game could be used to train people in creative thinking – a skill increasingly recognized as important in sectors such as healthcare. In this regard, the use of new digital technologies such as sensors for embodied interaction was important, both to deliver a seamless game experience and to trigger emotions such as *trust* and *surprise* that are associated with creative thinking and engagement (see Section 6.3.1).

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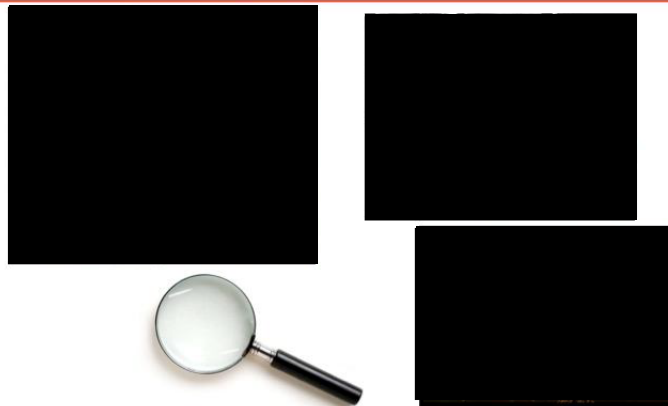
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Appendices

Appendix A-1: Mock-up



Player enters 3rd room of Virtual Care Home → Realizes the patient is missing... How to solve this mystery? Some artifact should transport player into the parallel world, like a portal...



...Player finds herself in a parallel world, where she is a detective.
Environment → office, 1950s, noir



The same tutor from VCH comes into the room, however, player notices that she looks much different now. The tutor approaches you like your detective boss, and makes a short introduction to scenario.

The Big Sleep

The Long Goodbye

Presumed Innocent

The Thirty-Nine Steps

The Poison Chocolate Case

Player is offered to choose her adventure. Each of the offered adventures addresses different issue related to dementia care challenges.

[catchy detective-vocabulary question]

NEW GAME

HOW TO
PLAY

RESUME
GAME

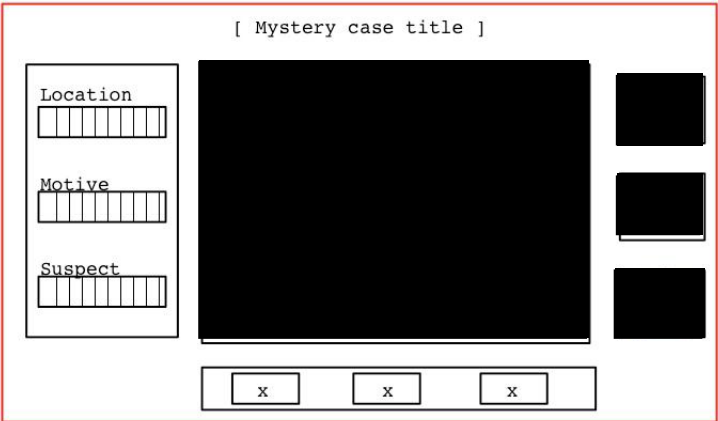
Dialogue window pops up. If the player is new to the game, she could go directly to NEW GAME; otherwise, there is an option to read the rules HOW TO PLAY. If continuing a previously saved game, player goes to RESUME GAME.



- [rule 1]
- [rule 2]
- [rule 3]

Tutor is back to explain the rules, if this option was chosen. Rules should be simple, complete and few.

HOW TO
PLAY

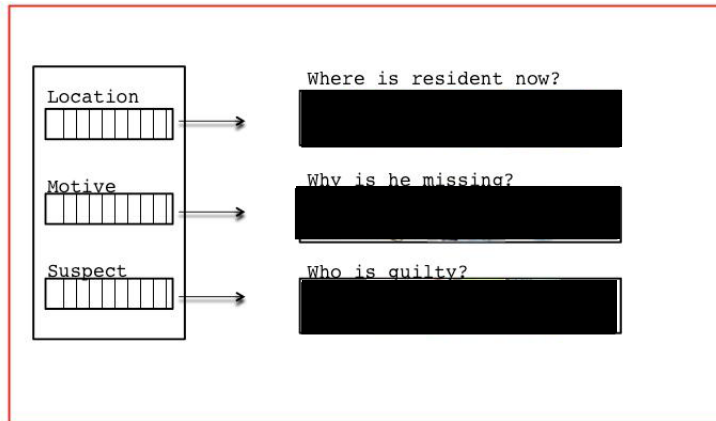


Game opens up. 2D interactive whiteboard containing multimedia clues that can be rearranged, slider categories of solution, solution combination space, link to notepad to keep track of your thoughts, counter of tries to make the solution (initial value e.g. 5) and button to ask for a new additional clue, which lowers counter down for 1.

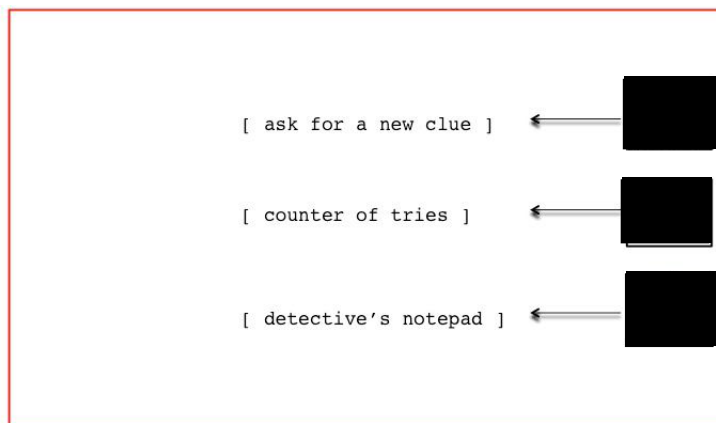
PLAY



Clues tell a story of the resident who is missing. Can be drag-and-dropped, rearranged and zoomed-in; can be viewed infinite number of times and with no time limit. Main challenge is in cross-checking of clues because not all of them are: relevant, complete, timely accurated which is something carers have to do every day in HL. Player uses elimination and association with bad/good practice to resolve conflicts in clue information. Some clues are generated as to look like player's reflections, while rest as of other people's, which contributes to reflective learning.



Choosing a winning combination of items, out of the wider sets of "Location", "Motive", "Suspect", player reconstructs where is resident now, why he is missing and who was responsible for that happening (carer, resident himself, other residents, family members...). Player learns to recognize various forms of abuse potentially rising in the care home.



Ask for a new clue, is a button, symbolized by tutor's image, adds an additional information to the whiteboard as help. However, that has a consequence, [counter]-1. There can be maximum X number of tries in guessing the right combination L-M-S, otherwise player loses. Link to notepad to keep track of suspicions.

[Mystery case title]

Location

✓

Motive

✓

Suspect

✓

✓

✓

✓

End of the game
 ([counter] > 0)
 ([ask for a new clue] → [counter] - 1)
 L-M-S drag-and-drop to solution space to guess a combination
 (labeled "Make your accusation!")
 Player should be offered to "CHOOSE ANOTHER MYSTERY", if she wants.

WIN 😊

[Mystery case title]

Location

Motive

Suspect

X

X

X

End of the game
 ([counter] = 0)
 The right combination not found →
 give choice "PLAY AGAIN" or "EXIT"

LOSE 😞



Adventure is finished, and you are back at the VCH...

Appendix A-2: Mock-up development roadmap

ROADMAP "DETECTIVE STORY" 2012-03-01

Imaginary needs:

- Decide which exact artifact is going to be used as a Portal (e.g. post-it...) – slide1;
- Decide contents of Introduction: environment, atmosphere, tutor dialogs (basically, everything that should appear on the screen) – slides2,3;
- Name set of titles of mysteries – slide4;
- Define catchy detective-vocabulary question – slide5;
- Define the exact formulation of rules – slide6;
- Define for each mystery: contents of clues, sets of L-M-S, sets of additional clues, dialog windows and communication with player at the course of the game and at the end of the game – slides8-12;
- Define who will take responsibility to answer on each of these points;
- Feedback parameters defined in the background if we want to have some – which are those, and how they are evaluated;

City needs:

- Check with users whether the current proposal is something they are agreeing with;
- Decide on how to introduce more explicit creativity techniques that aim to help player solve the mystery – explore and converge clues information space (e.g. "TRICKS OF TRADE" button which would randomly summon a creativity prompt that is relating to a certain creativity technique, chosen on the basis of which technique works best with: i) carers as specific users, ii) anatomy of the problem);
- Decide whether there should be more feedback parameters in the background that could inform research;
- Find out who and when is going to technically prototype game on the basis of specification documentation (Imaginary/students/third party from London...).

Appendix B-1: Call for participation

London, 29th June 2012

Dear Sir/Madam,

My name is Anja Sisarica and I am a first-year PhD student at City University London and its [Centre for Creativity in Professional Practice](#). My research is looking at applications of creativity and game-based learning in professional development. The problem domain I am exploring is dementia care, with a specific aim to improve quality of life in care homes by empowering carers in their person-centred approach to care. The work is supported by European Union project [MIRROR](#), where one of our partners is Registered Nursing Home Association. I am also working closely with [My Home Life](#) and supporting the best care values this organisation is promoting.

I am writing to you because I want to make a pilot study in the first half of July involving care staff. I would like to kindly ask you for your help in recruiting carers for my study. Please see attached my invitation to carers explaining the offer, and feel free to distribute it further to the members of your team you feel might be most eligible.

This pilot observation study should involve two groups of three carers each, and for each group the workshop will take two hours. Sessions will be audio recorded. Participants will be asked to: i) play one commercial board game, ii) take part in a role-play exercise, iii) contribute to a group debriefing session. Priority is given to less-experienced carers who passed the basic training. All ages and nationalities and both genders are welcome. If English is their second language, at least upper-intermediate level is required.

Depending on what proves to be more convenient for the groups, workshop may take place at your care home, or participants may come to City University London with travel expenses covered. We can set the date and time together, I am quite flexible. All materials for the workshop and incentives for the care staff will be provided by the project.

I expect this study to contribute both to my research and professional skills of the participants as well.

Thank you for your time. I will be looking forward to your reply.

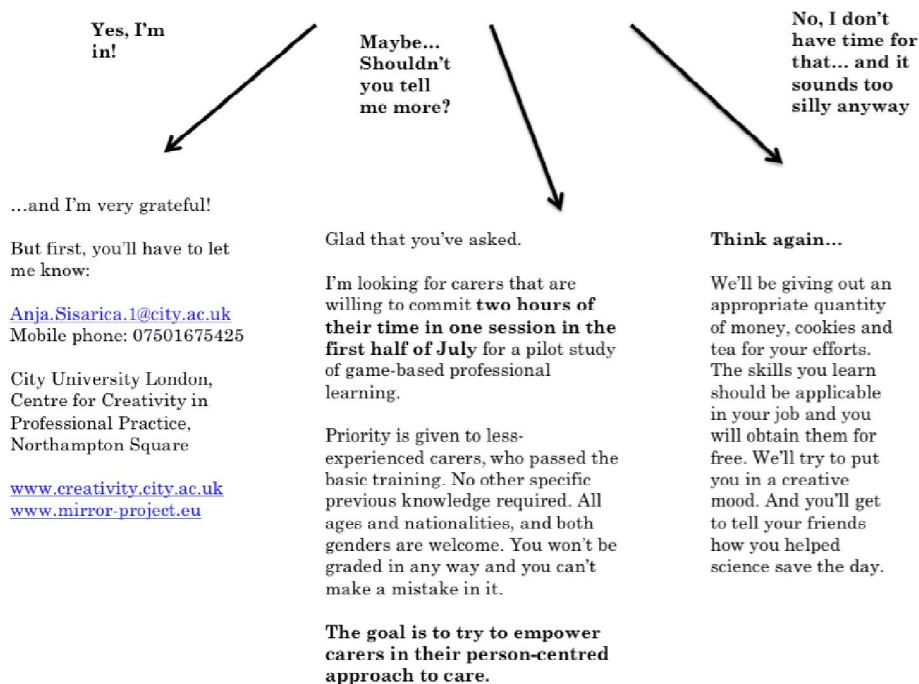
Kind regards,
Anja Sisarica

Dear Carer,

The happiest man is the one who manages to unify work and play in his everyday life.

With my PhD research at City University London – incorporating creativity, games and your professional needs – I would like to contribute to creating such working environments.

Can I count on your help?



Appendix B-2: Informed consent



Informed Consent Form for Project Participants

Project Title: Pilot study for PhD research project

I confirm that I have read and understand the project explanatory statement and have had the opportunity to ask questions.

☐

I understand that participation is voluntary and that I can withdraw consent at any time, without giving any reason.

☐

I consent to the feedback I give, either in written or verbal form, to be analyzed and reported as part of this project and understand that all data will be used anonymously.

☐

I consent to audio recordings being made of any verbal feedback I give.

☐

I consent to audio recordings being made of any interviews in which I am involved.

☐

Name: (please print)

Email: (please print)

Signature:

Date:

Appendix B-3: Explanatory statement



Thank you very much for participating in this pilot study.

My name is Anja Sisarica and I am a first-year PhD student at City University London and its Centre for Creativity in Professional Practice. My research is looking at applications of creativity and game-based learning in professional development. The problem domain I am exploring is dementia care, with a specific aim to improve quality of life in care homes by empowering carers in their person-centred approach to care.

The work is supported by European Union project MIRROR, where one of our partners is Registered Nursing Home Association. I am also working closely with My Home Life and supporting the best care values this organisation is promoting.

To reward your time and effort, you will soon receive an Amazon gift card (in the value of 20GBP) at the email address you provided in participant consent form.

If you have any further questions or feedback to share, please do not hesitate to contact me:

Anja Sisarica
City University London, Northampton Square
Mobile: 07501675425
Office: 02070408993

www.creativity.city.ac.uk
www.mirror-project.eu

Appendix B-4: Debrief questions in user observation study

1. How did it feel playing '221b Baker St' at your workplace today?
2. How comfortable do you feel with boardgames in general, and dynamics of this game? In your opinion, what are the advantages and disadvantages of playing a boardgame?
3. Now lets say we have a video game '221b Baker St'. What would be pros and cons of playing a digital version of it, on a computer or a tablet, in the network with your fellow colleagues, set in sort of a virtual world?
4. Which of these environments you find more engaging? More interesting? More comfortable?
5. How would you reflect to the role-playing exercise?
6. How much did experience of previously 'being Sherlock Holmes' help you in the role-playing exercise?
7. In your experience, to what extent is dementia care a bit like detective work?
8. Did resolving problems in such a deductive way make you somehow reflect on your previous experience?
9. How do you usually face problem solving in your everyday professional work?
10. What kind of game would you like to play as a part of your professional training?

Appendix C-1: Hazel Court v2.0 playtesting checklist

Hazel Court playtest @Codnor Park Residential Care Home, 6th/7th June 2013

CHECKLIST

- 3G iPad, mobile internet microSIM (<http://web.i-maginary.eu/static/hazelcourt/cover.html>)
- Projector
- Physical objects: Postcard, Doll, Car toy, Music CD, Headset
 - Shawl
- Cluedo character cards, board
- Flipcharts with Kristine's ground rules, clue collection sheet, MHL creativity triggers, blank flipcharts
- Paper reps of all the digital clues you have from paper-based playtesting
- Post-its
- Pens and markers
- Data collection equipment: two cameras, memory cards, tripods, photo camera
- Informed consent forms
- Explanatory statements
- Debrief questionnaire

Room setup:

One camera pointing at the table, the other one to the room, catching display on the wall. Projector on. iPad connected to wifi, open the game in Chrome. Cluedo board & flipcharts on the wall, character cards at hand. Physical objects scattered around the room. Place chairs around the table for four participants. Place consent forms, explanatory statements.

Appendix C-2: Hazel Court v2.0 debrief questionnaire

Please mark up to 5 adjectives that would apply to your experience today:

Appealing	Helpful	Productive
Boring	Ineffective	Professional
Confusing	Inspiring	Safe
Difficult to use	Intimidating	Satisfying
Dynamic	Intuitive	Straightforward
Easy to learn	Inviting	Supportive
Empowering	Naïve	Too technical
Engaging	Novel	Unattractive
Familiar	Overwhelming	Understandable
Friendly	Predictable	Valuable

Now please answer the questions below:

Did you feel challenged by the game?

How did you feel about making choices and navigating through the game?

How did you feel about sharing your ideas with the group? How was the feedback?

Almost done... Was it fun? If yes, what did you enjoy the best? If no, what would you like to see improved?

Appendix C-3: Hazel Court v2.0 playtesting timelines

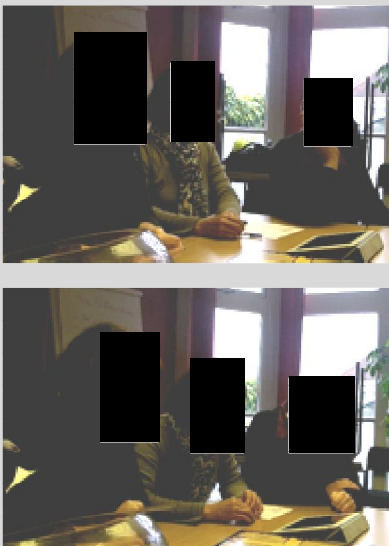
Session 2 (16/01/2013)

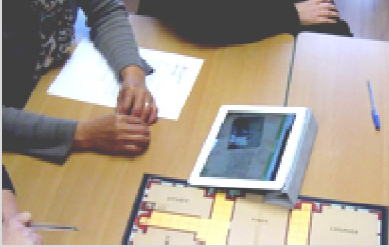
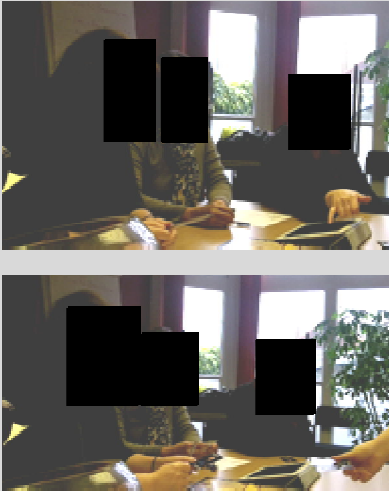
Participants: 2 female trained carers and 1 care home receptionist, from left to right P1, P2, P3, and facilitator F;

Work experience: P1 and P2 are experienced, whilst P3 had no direct experience in care; P2 could potentially have had an issue with language, her English was not very strong when speaking.

Total time: 53:11; duration of the playtest: 31:59;

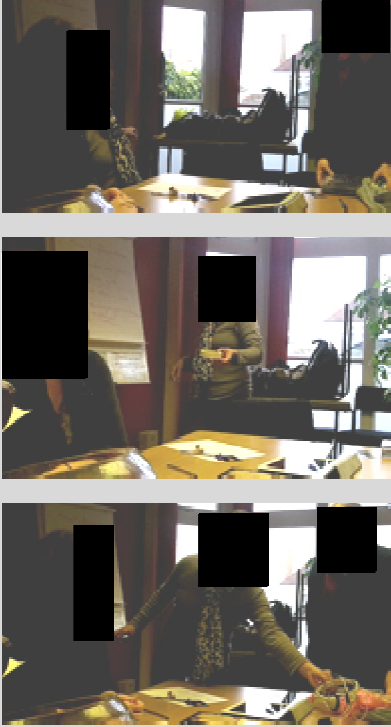
Source file(s): JanS2_Camera1.mp4, JanS2_Camera2.mov

Time	Description of activity	Image	Mechanics (CGBL)	Dynamics (CGBL)	Notes
00:00	Participants sit around the table, with Hazel Court v1 web app on the iPad in front of P2. F is on the other side of the room, watching but not assisting. Introduction page. They P2 starts the app, and P3 moves closer to P2. P3 asks P1: "Can you read it from there?"; P1: "Yes, yes." P2 takes upon operating the app; they read in silence, not commenting the content at all. P2 asks, looking at the other to: "You all right?" before changing to the next page of the Instructions. F asks: "How about those rules?", P3 "Yeah", and P2 skips the page.		RM	1	All 3 participants had only been informed that they needed to turn up shortly before the workshop. Participants 2 & 3 seemed to take a positive view on it, while participant 1 was not happy at all about having to participate. The climate in the room was sullen and negative to start with, mostly the source was participant 1. She was not resisting the game, but had very negative body language (e.g. sighing when the game was starting, frowned face). iPad keeps slipping from its magnetic cover stand when participants want to move it across the table.

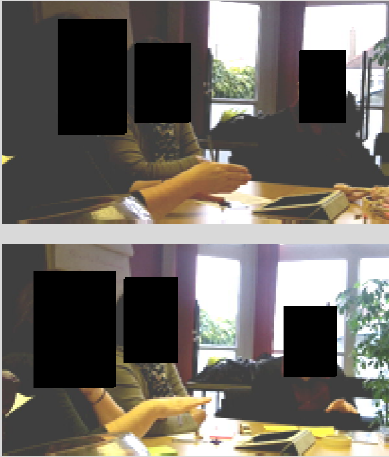
01:54	Meet the Blacks page - they read it in silence and with no reaction; until P3 says “Ok” and P1 indicates by body language, leaning backwards that she’s done, and P2 continues to operate the app and skips to the next page. Accidentally it’s pressed twice, so the Back button of the browser is used spontaneously by P2 to get them back to the characters from the Hall.		RM, Co	2	
02:20	Meet the characters page. Since there is no text on this page, P2 reaches for the ‘Next’ button but stops when F breaks the silence “So here are our characters. Feel free to get to know them and choose your role for today”; P3 starts opening character profiles “Shall we look all of them?”; F “If you like”. No reaction to character profile at first, until P3 spots Mr Green. F hands out character cards to players, P2 picks Prof Plum, and P1 picks Mrs Peacock. This manages to liven up a bit P3 and P2, but P1 remains indifferent. P3 “Just carry on?” and presses Next.		RM, Cu, Co	2	

04:37	They are on the Hall page. F says “So you are in the Hall now. Have you played Cluedo before? P3 nods yes, no reaction from other two. P3 spontaneously puts her green pawn on the board in Hall. Again, they read in silence. F retells the instructions “So, you are going to investigate what is going on in Hazel Court, you are going to go through rooms (shows the boards), and in each room you are going to meet someone, the person is going to say something to you, and also look around that room and search for one clue, in each rooms there is one thing that might give you a better idea on what’s going on with Mr and Mrs Black.” P3 “So we’re not actually using the board?”; F “Yes, not in the Cluedo sense, it’s your map for navigation mostly”; P3 places Mrs White pawn in the Lounge on the board and Miss Scarlet in the Dining room, according to narrative; F says “Mr Green has a sharp eye indeed”. P1 and P2 keep their pawns away from the board. Without speaking, P2 reaches for button to take them to see Mrs White, P3 says “Yes let’s go see Mrs White”.		RM, Cu	3	Wonder if the physical cluedo board is distracting. It seems to be distracting the participants.
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06:29	Players are in the Lounge. P3 “We can hear what she said, oh perfect”. After listening, P3 said “Did she give any advice?” No reaction from others, so she says “so you want to hear it again? Let’s hear it again”. P3 expresses confusion “Sorry did I miss what happened at the start? Did he fell over, is that it?” F “you’re investigating why the Blacks have been acting strange lately” P3 “Let’s find out more about Mr Black”, and presses Billiard room.		Co, RM, VC	3	The sound played by the iPad can sometimes be difficult to hear if there are other sounds in the room (i.e. traffic outside). Wonder if the use of the word “advice” is the right to use on the page where the participants listen to Mrs White. She is the gossip and makes a statement about the Blacks, but is she giving direct advice? No resident fall is mentioned in this branch so it’s interesting how participant was guided in this direction. P3 is doing most of the work and the talking, the other two are not contributing much.
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08:26	Treasure hunt introduction in the Ballroom. Because of the bug in the app, when the Back button of the browser is pressed, they are not taken to Billiard room, but directly to treasure hunt, F put effort to cover her surprise and continued by introducing the hunt for physical clues (“Your investigation has been interrupted because Mrs Peacock who said there are 6 more clues in this room, so maybe you should get on your feet and see what you find”). P3 is the one who collects most of the physical clues (F tries to encourage the immersion “well done Mr Green, well spotted”). P2 eventually joins in the search while P1 remains at table and points out one or two clues she spots. P2 finds and brings a duct tape, which was not one of the clues, F goes along with it. P3 asks “Something strange here! (laughs) Is it relevant where the clues are found?”, when they can’t find all the clues after some time, F introduced hot and cold play to help them, some happy screams when they find them eventually (10:40).		Co, VC, RM	3	Atmosphere seems a bit more relaxed after the treasure hunt.
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11:16	Re-examining the clues using the “whiteboard” page. F breaks the silence by retelling the prompt for finding meaning in the clues and reassuring them there are no right or wrong answers and putting the focus on the task. Whiteboard is a bit confusing for residents, as expressed by P3 (“Did we find them all, do these connect?”), because they didn’t meet Mr Green and collect all the presented clues due to app bug. P3 takes the initiative and zooms in the clues on the whiteboard. F “Do you have any questions at this point, Prof Plum looks at me a bit confused”; P3 “You have all these objects you ask us to discuss them but there’s no obvious reason to discuss them... the postcard as a clue of why they are acting strange, maybe somebody’s coming to visit them?” P1 “Maybe they used to travel a lot before dementia and now they can’t, maybe someone misses them, maybe they used to travel a lot and now they can’t”, and she continues sharing her associations to each physical clue, e.g. doll prompts discussion on childhood memories of residents or playing with their own kids.		RM, F, VC	5	The group requires a lot of help and prompts.
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19:57	When doing brainstorming, the group does not write anything down on post-its, even after significant prompting. P1 gets animated when talking about her experience as a carer and the situations she encounters there. She has mostly negative experiences to share ("Maybe music is related to forgetting how to play piano. I have a piano teacher who can't remember how to read notes, she's just automatically sitting there in front of the piano, but can't remember how to play, it's really said, it really upsets her"). It is clear from what she is saying that she does use a form of "detective" work in her job ("...when someone is upset or crying, one can do a little investigation on why..."), though does not seem to have a mental mapping between this and the detective element of the game. P2 tries to join in towards the end, but P1 speaks over her. Most of the conversation consists of P3 asking questions of P1, who shares a lot of examples from her practice (e.g. "Is dementia life-threatening?"). The creative process did not go through planned Combination and Transfer from excursion stages. Ending at 31:59.		VC, F, RM, Cu	5	<i>The clues seem to have an effect of Rorschach test, where due to their ambiguity, participants see the reflection of their inner thoughts and feelings.</i> <i>P3 might not have as many associations as P1 and P2 as she is not directly involved in the care process, and uses the opportunity to learn from the others. There seem to be a lot of reflection and useful discussion on person-centred methods of care, but participants did not engage in the creative process as planned. The climate in the room at the end of the session was much better than at the start and the participants seemed to enjoy the discussion element of the session.</i>
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Question	Responses	Notes
ALUO (Advantages & Limitations)	P3 “Board just didn’t play a part, it was only confusing”; P1 “If you focus on this and this, it’s distracting” (showing iPad and the board); P3 “Using the iPad, the talking, the flipchart board, the game, it doesn’t... I don’t know”; P2 “If there was a bigger screen?”	Re-think the role of the physical board as a resource. Consider a medium other than iPad for display, which has a bigger screen. It seems as if the participants were overly challenged by the VC mechanic, disturbing their attention.
How was it for you? How did you feel in the gameplay? How challenging was it? (CHALLENGE)	P3 “It’s funny how I understand the game much more now when I’ve finished it, so if we were to start again, I would know exactly what sort of thing we would be looking for, without the confusing start...like if you had this thing from the end in the beginning, it would make more sense to play the game, we would know what we are looking for and what to make of it”	Think about how to balance VC with giving instructions in the beginning. Interesting quote about transfer options of creative learning outcomes in terms of skills?
Is there something in the game that personally appealed to you? (FREEDOM);	P1 “I was just thinking now, when I was working on the ward for the dementia, I was just saying to myself - god, this is a mad house, I’m just playing roles all the time... to understand them, I must just play roles, I’m just sometimes pretending I’m a kid or someone else who they know... I must go to their level to understand them”	Interesting quote about role-playing application, transfer.
How did you feel about sharing your ideas with the group? How was the feedback? How open were people in the group? (IDEA-SUPPORT, TRUST & SAFETY);	P3 “What I’ve picked up from this, about dementia, since I’ve not been working in care, from you and what you said (pointing at P1), that the game, listening to some real stories makes the things much more real”	
Was it fun? (HUMOUR & PLAYFULNESS)	P3 “I liked the hunt, that was the best part”	

Session 3 (16/01/2013)

Participants: 2 participants. From left to right: P1 & P2. P1 is the first male participant. He works as a finance manager for the trust and is not a carer but has experience in caring for his mother-in-law when she had late stage dementia. P2 is an experienced female carer.

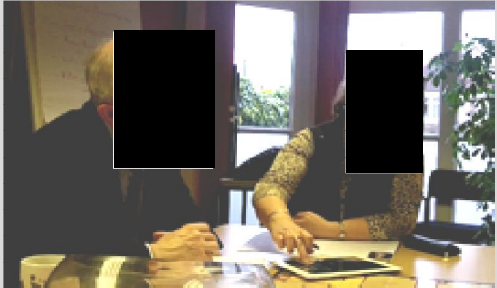
Work experience: P1 works as a finance manager for the trust and is not a carer but has experience in caring for his mother-in-law when she had late stage dementia. P2 is an experienced carer.

Total time: 51:55; duration of the playtest: 37:05;

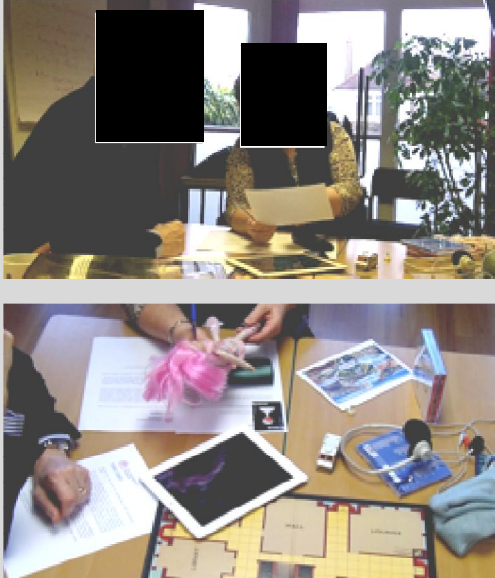
Source file(s): JanS3_Camera1.mp4, JanS3_Camera2_Part1.mov, JanS3_Camera2_Part2.mov

Time	Description of activity	Image	Mechanics (CGBL)	Dynamics (CGBL)	Notes
00:00	Introduction page - P1 presses play - they read the instructions, whilst P1's body language signals that he is paying attention to P2 and how she's getting on, and when she seems ready asks "Done? Carry on, shall we?" and goes to the next page of the instructions (01:27). They have some trouble making the game move from one page to the next and need some help with the technology (P1 "We should hit it harder, do we?", referring to the Next button).		RM, F	1	The climate in the room at the start is friendly and positive.

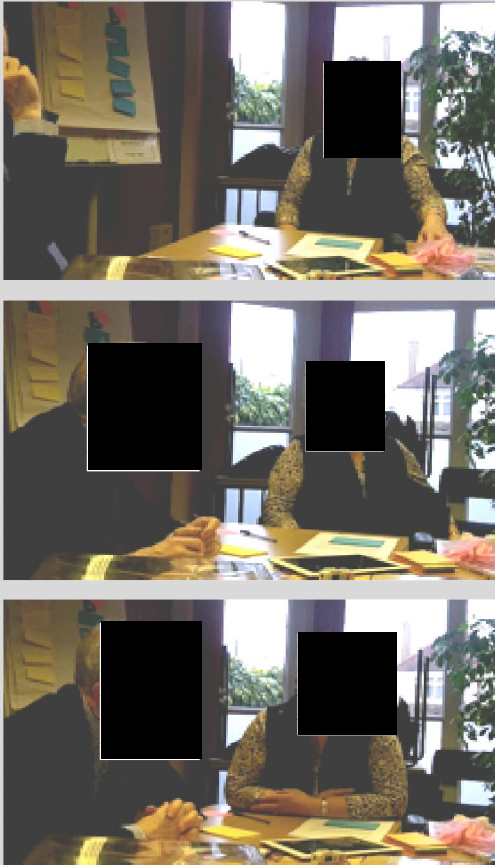
02:23	Meet the Blacks page. P1 asks P2 “Can you see alright?”, P2 “yes”, P1 says it’s a bit difficult to read due to glare from the lights from the ceiling. F “So today we will be looking at what is going on with Mr and Mrs Black”, both players react affirmatively, but don’t comment further.		RM, F, Co	2	
03:09	Meet the characters page. F “Here are the characters, now you get to know them and pick your role for today”; players start exploring the page and have little laughs whilst reading all the profiles (03:42, 03:56). P2 picks Mrs White, and P1 Colonel Mustard (P2 “Real gentlemen!” - quoting from profile, P1 “Sheer chance!”). They seem to communicate well and listen to each other, which can be noticed by their body language. They take turns on operating the app at this stage.		RM, Cu	2	iPad slips from its magnetic cover case, so they decide to take it away completely.

05:20	They are on the Hall page. F “So in each of the rooms you’re going to visit there is a clue, watch out for the yellow frames, just note them for now and then we’ll see later what we’re going to do with them”. P2 picks where they will go next.		VC, Cu	RM,	3	
	Players are in the Lounge . They don’t notice the sound button, F steps in to help. They listen to the character statement but miss the clue in the room, regardless the instructions in the previous step.		Co, Cu		3	The participants were looking for clues in the background of the rooms and not seeing the provided clues stating later that they dismissed them for being too obvious.

07:22	They find Mr Green in the Billiard room . Again they miss the sound button for Mr Green, this time completely, even though F says “You could hear what Mr Green has to say”), and the app doesn’t have the back option. P2 skips to the next page.		RM, F, Co	3	P2 suggests later that the sound button should be larger.
07:55	Treasure hunt introduction in the Ballroom . F tries again to make them spot the clue in the app first, but it goes unnoticed, so F says “So it’s time to look around this room for clues that will tell you more about Mr and Mrs Back”; P1 “This room?” F “Yes, go around and see what you can find” P2 is pleased when she finds CDs in the flower pot. Some laughter when they find a dolly on the top of the whiteboard in the room and a scarf tied up to fire extinguisher. They look again at the Ballroom page but still cannot spot the clue in it (11:23). P1 “Maybe it’s something too obvious so it goes unnoticed”		VC, RM, Co	3	The clues in the rooms are a bit too obvious, and may need to be hidden a bit more, or made more obvious.

11:53	Re-examining all the clues using the “whiteboard” page, and inspecting the physical clues. After some moments in which players seem a bit stuck, F encourages them to explore the clues by explaining the elements that one can see on the whiteboard (character statements, clue images they can zoom in), and prompts them to assign clues, both digital and physical, a meaning of their own form the perspectives of their characters, reassures them that there are no right or wrong answers. P2 picks postcard first, see it as a memory card to talk about holidays with Mrs Black; then the doll, associating it with doll therapy as a “tactile thing Mrs Black might enjoy”. Combination – they could not make any connections between the objects explicitly, though seemed to do so when it came time for brainstorming. They had not heard all the clues (i.e. Mr Green).		RM, Cu, F	5, 6	
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19:38	Brainstorming page. F introduces the technique, and they individually apply it, writing down ideas on post-its. They share the ideas from the point of view of their character (25:45) (e.g. P1 “Mr Black broke his hip so Colonel Mustard can take him on a trip by car instead, and they bring the scarf to feel warm all the time, regardless the weather”, where car was one of the clues and we heard from Mrs White that Mr Black broke his hip, and scarf was another clue), and they seem to enjoy the discussion.		RM, Cu, F	5	
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30:39	Transfer from excursion happens naturally without visiting the last page. P2 “You have to act like a detective when caring for someone with dementia because they often forget where they leave things or don’t recognise them, or pick up things that don’t belong to them, so in a care setting a resident tells you another resident took something of theirs and went along with it, so you have to go on a hunt for that object and predict where it will be... that’s a classic... and also, like a detective, you need to know something about that person you are caring for, so it’s a bit for detective work to find out something about their lives” P1 “exactly” P2 “you need to be in contact with their family, friends, that sort of a thing and I would encourage regular visits... sometimes residents find it hard to communicate with their loved ones, so we need to be there to help them, make them feel understood... some I’ve seen in the past won’t come, because it’s easier not to come, because that person maybe won’t recognise them, even if they are their son... like Colonel Mustard” (laugh) P1 then reflects on caring for his mother. More reflections. Ending 37:05, they see the last page and continue reflecting.		F	5	Session ended with a positive climate and players seem satisfied. Some examples of successful transfer of domain-specific learning.
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Quote from debrief: (45:28) P2 “This colour is brilliant for people with dementia (takes an orange post-it block). If they can’t see anything...could you pass me your phone? (takes F’s phone) ...if you put that on there, that’s what I like to do. If you have some a brown table under there they might not see it. So if you use an orange block, tablecloth or a mat, put it there, they will immediately go to it”; P1 “Would it work with yellow or red?”; P2 “It’s just been trialled that orange is the colour, I think both would work to be honest, they’re both bright, but out of the two, I would go for orange, it would highlight it... (takes a little car from the table and demonstrates the concept by putting it on the block) ...if you want them to eat their food, best to make the table clear, and just put it on there, something orange. You can’t have vase with flowers, box with chocolates, box with pens, because they will get distracted.. ooh what’s that, and dinner’s gone, time’s been finished and it’s been taken away and they’ll wonder where did it disappear”; P1 “It’s like living with my grandson who is 2, you have to keep them focused”; P2 “You almost need to treat them like a child... not treat them as such, but think - what would you do in that situation?”; P1 “Absolutely”.

Quote from debrief: (48:34) P2 “We had some dementia training here at LOT, and a rummage box came out of that. One lady turned up the next day and brought a box for a person living here with dementia. Just had a table cloth, stringy beads, lots of different little things, and he opened it, looked at it, closed it and pushed it away...‘that’s not mine’, he said... so, I went back home, I found some old magazines, he liked 60s music, so I cut out of magazines bigger pictures... there were The Beatles, Jo Brown.. I found picture of (?) Black, and he recognised her and he wore around the picture for two weeks until it fell apart, showing it around because he recognised her, you know, ‘this is mine’, it definitely did work... and there were old photographs in there, there were football trinkets, a ticket for a game of his favourite football team, and a little notepad where he could jot down his sister’s name, when did he last see her...when he went to the hospital, they needed to make a file on him, and I brought the rummage box so it came out again... it there wasn’t that something, I think he would get up and walk away... later he got a bit bored of it, but it worked for a little while and it worked well”; P1 “It was his comfort zone”.

Question	Responses	Notes
ALUO (Advantages & Limitations)	P2 “I think the objects were a good idea, it was good to play around the room and make us see what exactly we need to do in our roles at work, really, so that was good”	
Did you feel in control of what was happening in the game? (PERSISTENCE)	P2 “I was a bit tired this afternoon, but it was good”; P1 “I was confused, I couldn’t really see a point where we’re getting to for a while”; F “When was the moment when it started making some sense?”; P1 “When we started relating these things (pointing at objects) with what we could be doing with the Blacks or the things our roles would be doing in that situation”; P2 “Maybe having the symbols larger on the overview, or maybe getting them to come out one at a while rather than six and then you concentrate at one thing at a time... it’s a bit too busy, isn’t it? You’re looking at this, you’re looking at this, you’re looking at that... simplifying, that’s the word, really... the background was too busy, and then I was seeing more into it than there was...the idea is really good but it should be simpler”	Similar comment in S2 about the need to simplify input. Confusion about the meaning of the first level of dynamics and clue representation. The need for a better balanced VC. Triangulate with the “orange block “excerpt and participant’s need for order, coming from her professional background.
Did you feel time pressure? (PERSISTENCE);	P2 “You left us to go at our own pace, and helped us with a bit of prompting, that was good”	
How did you feel about making choices? (FREEDOM);	P1 “Not in control”; P2 “It took a while to get into it... to pick a person, that was good, so you’ve got your character”	
Was it fun? (HUMOUR & PLAYFULNESS)	P1 “It was fun but not comfortable, I didn’t want to let you down”; P2 “You get what you put into it really”	P1 felt pressured to perform, interesting quote.

Session 4 (16/01/2013)

Participants: Group of 4. Two men and two women. From the left as: P1, P2, P3 and P4. They all know each other from before, and work together.

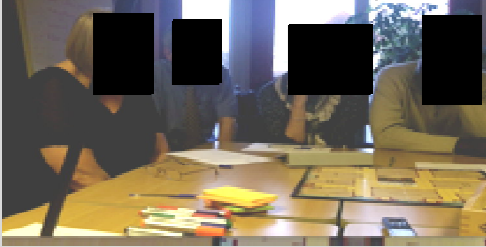
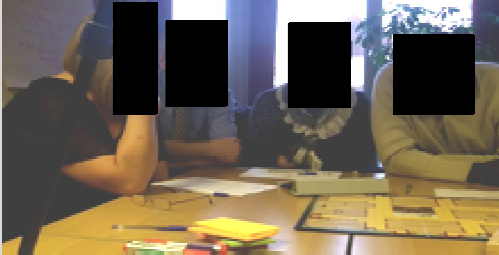
Work experience: All experienced carers.

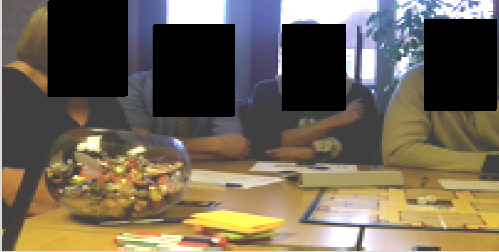
Location: LOT, in a spacious meeting room

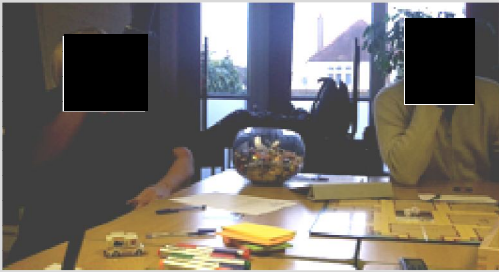
Total time: 01:04:31; duration of the playtest: 47:30;

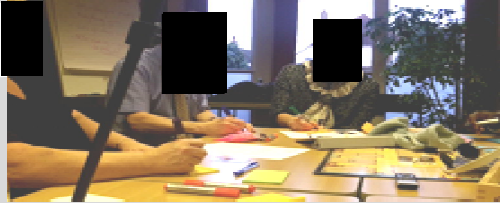
Source file(s): JanS4_Camera1.mp4, JanS4_Camera2_Part1.mov, JanS4_Camera2_Part2.mov;

Time	Description of activity	Image	Mechanics (CGBL)	Dynamics (CGBL)	Notes
01:25	Introduction page. P1: "Do you want to read aloud Rachel?" P3 reads out the text on the screen as the screen is too small for everyone to read and the writing is a bit small for one or two to read. This reading out adds something extra to the game. P3 adds a bit of dramatics to her voice as she reads and the group seems captivated. This seems to be entertaining for the group and there are laughs and smiles. F gives additional instructions on spotting the clues.		RM, F, Cu	1	Reading out loud seems to add to the engagement of the group. This group kicked off with most fluent collaboration - could it be due to the fact they know each other from before, or their numbers impose more teamwork in order to follow what is going on?

04:32	Meet the Blacks page. P3 continues to read out loud; more giggles and smiles. When she finished reading, she looked at everyone for approval to go on to the next page. P4 reaches for the button (P3 whispers 'thanks').		RM, Co, Cu	2	
05:14	Meet the characters page. They spend a long time choosing characters and laugh when reading the characters; they engage with the roles (e.g. "I can't be Mr Green, I don't like tea"). Eventually they settle on characters (P1 - Mrs White, P2 - Prof Plum, P3 - Mrs Peacock, P4 - Miss Scarlet).	 	RM, Cu, F	2	It's interesting that male participant would choose to a female role and vice versa; more different a role from the original, more domain distance - novelty it could trigger?

09:07	They are on the Hall page. P3 continues to read. There is group discussion about where to go first and everyone agrees on Mrs White.		RM, Co, Cu, VC	3	
10:15	Players are in the Lounge . They find it difficult to spot the sound button, P2 points it out. P3 reads out the options. F reminds them there might be another clue there they're missing. P4 "What do we do if we spot a clue?"; F "Just note it for now and we'll see what you can do with it in the future". They discuss together where it is best to go next, and opt to find out more about Mr Black's habits.		RM, Co, Cu	3	

	Billiard room where they meet Mr Green, and have no trouble finding the audio button this time. They replay the audio on P2 and P4's request. They identify the clue hiding in the room, and discuss together where to go next.		RM, Co, Cu	3	
13:59	Treasure hunt page. P3 reads out loud again. They find the third clue in the room, and seem surprised and intrigued by the invitation to search in the actual room (both P1 and P4 ask "in this room?"). P2 and P3 go about to explore, whilst P1 and P4 look from their seats, and eventually join in too. P3 organises the clues everyone collected on one pile.		VC, RM, Co	3	Only group that found and discussed all three clues. Perhaps reading out loud and extra facilitation helped in clarification of the task.

16:26	Re-examining all the clues, one by one, using the “whiteboard” page, using the app first. F provides additional clarification/summary of what they found. P4 tries to zoom in the clues using iOS gesture for zooming in, F clarifies one just needs to tap on the icon. Players did not engage in Combination, and F didn’t insist.		RM	5	This group engages with the digital whiteboard more than with the objects.
23:01	Brainstorming. Only one of the group generated ideas when asked to do so - P2, even after significant prompting. The others wrote down what the clues could mean or meant to them. There might have been confusion about task. F facilitates sharing of the outcomes. Players don’t relate to their characters in this activity.	 	RM, F, VC	5	The third level of dynamics was almost entirely facilitated by F, rather than creativity prompts implemented in the app.

40:38	Transfer from excursion page. Everyone seems in good spirits. P3 “I think you have to well aware of... everything. People’s feeling, ideals, beliefs. We keep quite thorough notes”; P2 “It’s important for when someone new comes in”; P3 “Yeah, the dynamics of working with that particular person... that’s the most investigative part”. When asked about how applicable they find the type of ideas they generated in their practice and their feasibility, they say they’ve done even more in terms of person-centred care, as they are quite experienced. P4 gives an example: “Take the ‘DJ - headphones’ association... we have a resident who likes to buy CDs when he goes out, he goes to a shop corner, puts headphones on, and sits there listening to music, he knows exactly what he wants and we help him get here”. Ending at 47:30.		F	/	The climate in the room throughout was good. The group seemed very positive about the game, but stated that it might not be appropriate for their own experience level. They had some interesting ideas of how to add to the game.
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ALUO (Advantages & Limitations)	P2 “I liked that” (pointing at the iPad); P3 “It’s quite easy to use, isn’t it?”; P4 “It’s just like a bigger version of this” (shows his mobile phone); P2 “Yeah, it’s like a book you can read, flip pages”; P4 “If you bring a projector, you can plug it into here and project there” (showing towards the wall ahead) and the others like the idea	Projector idea
How was it for you? How did you feel in the gameplay? How challenging was it? (CHALLENGE)	P2 “I have to admit that for the first 20min, maybe half an hour, I didn’t know what was going on...I didn’t understand what the overall objective was. If you just said imagine these two people in your home, there are some issues, and you are going to establish what they are, you are going to be exposed to different clues... I would put it together. But I’m thinking, like, we’re looking at this, then finding clues, and then in the middle is the Cluedo board, and the flipchart... it didn’t quite come together without the finishing summary we did, but I did enjoy it”; P2 “We probably didn’t really need the Cluedo board, did we?”; P3 “Or the characters?”; P2 “I couldn’t relate my brainstorming with my character”; P3 “Yeah, my brainstorming would be from me, and not Mrs Peacock”; P1 “But I did enjoy being Colonel Mustard and didn’t feel difficult”; P3 “Maybe it depends on the person, maybe we should embrace it”; P1 “You can make the clues even harder”; P3 “I think for somebody new in the field, they would get a lot out of it, because we already sat through hours and hours of training on dementia”; P2 “What I’ve got from this, is that never really is a right answer, all those ideas up on the board, we were all thinking sort of on the same lines and there’s no clear reason why individual idea should be better than another”	More straightforward introduction of the objectives, issues with too much input too quickly, confused players until the third level of dynamics. Cluedo board and characters reported redundant. Interesting quote in the end - proposing a need for some sort of feedback on the quality “immediate creative outcome” for participants to do better selection?
How did you feel about sharing your ideas with the group? How was the feedback? How open were people in the group? (IDEA-SUPPORT, TRUST & SAFETY);	P4 “You have your opinion, and I’ve got mine, we all listen and it all comes together”; P3 “I think we worked well as a team”; P1 “We saw how something quite trivial can lead to a situation in some way”; P2 “You just have to think ‘why’ and discuss things, talk with your partner, colleague”; P1 “...Communicate”; P2 “We got to communicate our values, how you treat people, explore, rather than, you have to do this”; P1 “...Research”.	
How did you feel about making choices? (FREEDOM);	P2 “It seemed quite logical... one conversation leading to another”; P4 “But you can’t just follow... in this job, you have to look, when someone says something, he may mean something completely different if they have dementia, you have to go there and find out”	

Appendix C-4: Hazel Court v2.1 playtesting timelines

Session 2 (06/06/2013)

Participants: From left to right 4 older female carers, 10+ years of experience in the sector, P1-P4, F - facilitator, O1 and O2 - external researchers who are only observing the session in the background;

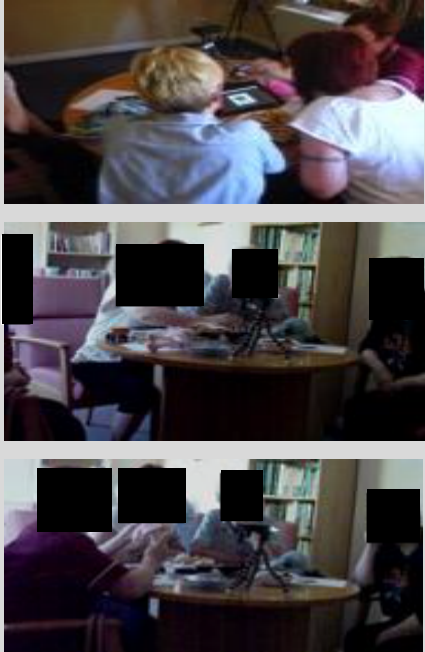
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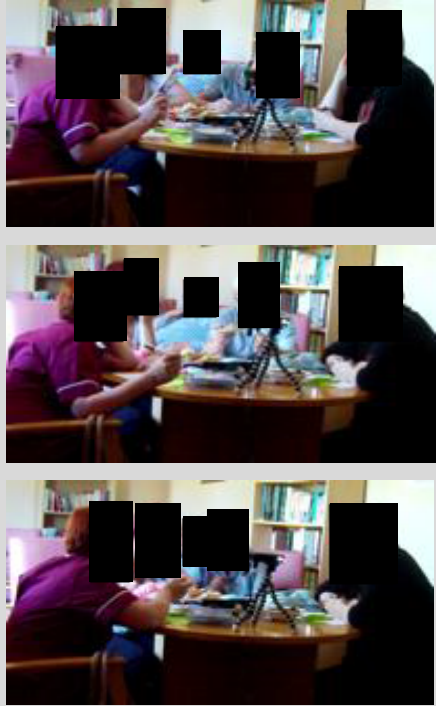
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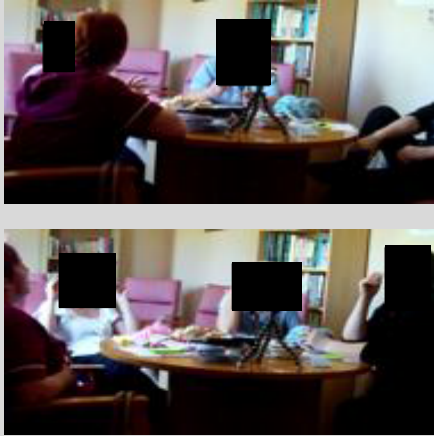
Time	Description of activity	Image	Mechanics (CGBL)	Dynamics (CGBL)	Notes
00:00	Introduction: F does the warm-up: explains the creative learning objectives of the game and the game premise, reads out the first two pages of the app, and explains how to use the app, what to pay attention to and what is going to happen along the way. F doesn't interact with the app, but encourages Ps to press Play and Next. Because the climate in the room is a bit stiff, F decides to do one of the pre-prepared ice-breakers ("say your name and how you're going to be today"). Participants react well to this and there is some laughter and chatting among participants.		RM, VC	1	Climate change in the room after the ice-breaker. All participants know each other from before, as they work together. No usability problems even though users are older ladies. Adaptability of the facilitation to the group - VC.

04:25	Meet the Blacks: P3 reads out the prompt and has some problems with readability (“it could be larger for us elders”, and all Ps laugh). They don’t comment on the contents, P2 presses Next.		RM, Co	2	Some adjusting was needed on projector to maximise readability.
05:30	Meet the characters: F gives additional explanations, and then P3 continues with reading. They have fun exploring the character profiles and picking their roles; there are no usability problems.		RM, Co, Cu	2	/
07:34	They are on the Hall page. F gives additional explanations; P3 “No candlesticks and ropes today, eh?”. P3 suggests P4 continues with reading, as she is closer to the screen. They quickly agree to go to Dining room next.		RM, Co	2	Again small issues with readability. Some problems with loading (they had to press 3 times to get to the next page).

10:31	Players are in the Dining room . Players needed prompting to recognise both the digital clue and the audio button. They briefly discuss the clues before going forward. P1 wasn't participating much up to this point, but joins in now, "Let's go to Library".		RM, Co, F	3	/
12:58	They are in the Library , where they find Col Mustard. For a couple of second nothing happens, then P1 reminds P3 to play audio. They don't comment much on what Col Mustard said, but notice the digital clue and talk briefly about the meaning of it. In the end, they decide to go to		RM, Co, F	3	/
15:02	Treasure hunt introduction in the Conservatory . One participant brings a painting from the wall that wasn't part of the designed set. Again, they bring in the catbed. Laughs; they seem to enjoy it.	 	RM, Co, Cu, VC	3	More emergent behaviour.

16:52	Re-examining all the clues using the “whiteboard” page: F helps Ps to summarise their findings and asks them to brainstorm associations and talk about the meanings of the things they found. They focus more on the digital clues and app-lead exploration. After Ps briefly went through all the clues, F asks them to make associations in the context of care for the Blacks, P1 starts first, and then P3 combines all the clues into one story about the Blacks.		RM, Cu, VC, F	5, 6	Combination happened not as planned, but was relatively successfully done orally, merging inspiration from all the clues into one story.
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22:42	Brainstorming headlined ideas about care plan changes of the Blacks, first individually, introduced by F. P1 “Are we allowed to talk amongst ourselves?” F “Of course you are, you’re not in the army, you can do whatever you like” P3 starts group discussion, taking one physical clue they found (£1 note) “We can copy money, it would seem real, give it out like wages if they’ve done a bit of work”, and they continue discussion in group, in parallel with writing down ideas; after 2-3min when they seem done F asks them to share and explain their ideas in turn (28:43). There are a couple of similar ideas, so F clusters them together on a flipchart. F asks if they’ve tried something like they propose already in their practice, and they say they have, and reflect on their practice (e.g. triggered by a doll clue association, P3 tells a story about a resident who used to be a midwife and how they used to do a doll therapy with her, in relation to her profession, in another care home but when she came into this one, “social services wouldn’t let us do it, they said it wouldn’t be appropriate”; F “What did you do then?”, P3 “There’s nothing much we could do, she has her ups and downs...”; F “What other objects could you use to connect with her?” P3 “Teddy bears maybe”).		RM, Cu, F	5	Similar ideas due to group discussion during brainstorming? Again, low novelty in the organisational context. Evidence of carers’ workplace being limited by management in creativity application (e.g. doll example).
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34:40	Introducing creativity triggers F asks them to pick one idea from the flipchart they haven't tried yet to analyse it in the context of the triggers, P1 "we've done most of them already", P3 "but maybe swimming, though it'd be difficult", F "don't worry, it doesn't have to be feasible, you're not committing to anything at this point", and they seemed more relaxed after this reassurance. P2 "Let's do cinema then", P4 then reflects on a case in her practice with a resident really wanting a Starbucks cold coffee - and that that is an example of something doable, quick and cheap, and that cinema is like that (37:00), and discussion continues in a direction of scaling down, how unfeasible ideas could be adjusted into doable actions (e.g. "we can't take her perhaps on a trip in a hot-air balloon, but we could take her to a hill with a nice view"). P2 "We don't think about these things, we have activity people", P3 "It's funny how when you help them get washed and dressed in the morning, you don't realise you're already doing an activity with them, you're talking to them all the time, you get to know all sorts of things about them"; eventually, after more help in focusing, Ps come up with one final idea they haven't tried before: P2 "set up a big screen in the care home..." P3 "play a film to watch with a family..." P1 "with a grandson on the lap".		RM, VC, F, Cu	5, 7, 8	Skipped combination. Needed reassuring because they don't feel like decision-makers, but feel the pressure to perform. They are very cautious about trying something new; novelty push needed. F adapted the technique to the group, to try to externalise one thing they haven't tried before using the triggers. Climate in the room is positive.
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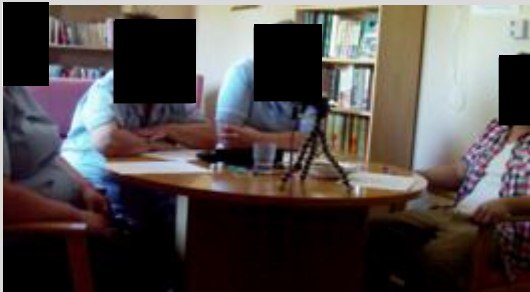
41:21	Transfer from excursion: Ps discuss the potential application of what they've learned through the experience and being a "detective" in a care home and creating solutions for dementia issues. Wrapping up, F goes back to creativity triggers, encouraging Ps to try out the creativity techniques they've learned in supporting these 3 themes in their practice. Ending at 46:15.		F	/	Whilst Ps seemed to have enjoyed the training and realise the potential of being more perceptive, they didn't really embrace the need of upgrading their creativity skills (P3 "When you said think about something you haven't tried before, I didn't know, we do it all"), and they don't seem organisationally supported in employing them.
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Session 3 (06/06/2013)

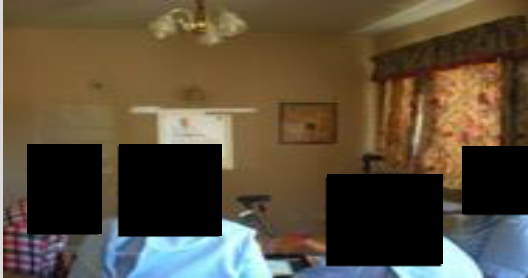
Participants: From left to right P1-P4, 1 younger female carer, 2 older female carers, 1 younger male carer; P2 & P3 have 10+ years of experience in the sector, whilst P1 & P4 are newly employed carers; F - facilitator.

Total time: 52:18, duration of play session: 47:00;

Source file(s): JunSession3.mov

Time	Description of activity	Image	Mechanics (CGBL)	Dynamics (CGBL)	Notes
00:19	Introduction: F does the warm-up: explains the creative learning objectives of the game and the game premise, reads out the first two pages of the app, and explains how to use the app, what to pay attention to and what is going to happen along the way. F doesn't interact with the app, but encourages Ps to press Play and Next.		RM	1	P2 and P3 know each other from before, so they make comments between themselves, not really acknowledging the rest of the group.
03:29	Meet the Blacks: F asks Ps to take over reading out loud, P2 takes lead. They giggle at the mention of Col Mustard - they are all fans of Cluedo, as they admitted in the beginning of the game. No questions nor comments, they go straight to the next page.		RM, Co	2	Climate is becoming more relaxed as the game goes on.

04:36	Meet the characters: P2 takes charge of operating the app, but she doesn't read aloud and they don't discuss the characters amongst themselves, even when prompted, but when asked to pick their roles, they start to relax more. When P2 struggles with a button, P1 helps her, actively participating in the session for the first time. F hands out cars as physical tokens.		RM, F, Co	2	P2 takes lead and doesn't pay much attention to P1 & P4 at first, but then they start collaborating. Notice the body language from the beginning to this scene - how P1 & P4 come closer as the climate relaxes.
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09:19	They are on the Hall page, where they begin the investigation. F against prompts someone to read out, P2 volunteers. They quickly agree to go to Lounge next.		RM, VC	2	Climate in the room is back to being reserved, they seem cautious. Not as much immersion with the contents as in other groups; P2 is leading a quick tempo.
10:14	Players are in the Lounge , listening to Mrs White. They don't discuss the contents, even after prompting, and after they've successfully spotted the digital clue, they go straight to the Billiard room.		RM, Co	3	/

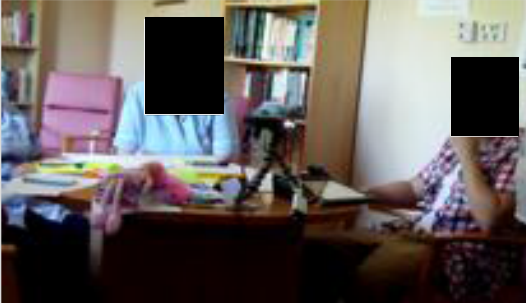
11:47	They find Mr Green in the Billiard room . They listen to his story and they find the digital clue, but no reaction or discussion occurs, regardless the prompting. P3 just asks others where to go next.		RM, Co	3	They still don't seem to connect well as a group. Maybe one of the key factors to the flow of the session is having a group who knows each other from before and works together? It's interesting to observe if the climate changes from beginning to the end.
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13:36	Treasure hunt introduction in the Ballroom. Ps seem amused, laughing. In the excitement, they knock down the projector and camera was moved, but no damage was made. Everyone comes back with some clue, but no emergent behaviour.		RM, Co, VC	3	All the cables around projector, camera, iPad - may constrain the game space.
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16:39	Re-examining all the clues using the “whiteboard” page: F helps Ps to summarise their findings and asks them to brainstorm associations and talk about the meanings of the things they found. Ps focus more on the physical objects in front of them, taking them one by one. P1 leads the discussion, whilst others seem a bit confused. P2 mentions the wages idea that was mentioned in the previous session as a practice of the organisation.		RM, F	5	The mention of the same good practice example signals how good ideas can get shared through teamwork reflection in everyday practice.
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19:36	Combining associations into headlined ideas about Blacks' care plan changes: Ps are successful in generating headlined ideas, but combination is not successful in a designed way, because they associations weren't written down in the previous step. They seem to enjoy it, although they seem a bit confused at the beginning as they have no previous experience with brainstorming, as they said when asked by F. F challenges them to come up with ideas they've never tried before, in order to increase overall challenge of the session, given the experience with the previous group and work experience of this group. F encourages them "You can't come up with anything wrong. Think about that awesome idea with the money you have been practicing around here. Somebody had to come up with that, right? So, I believe you guys can come up with cool ideas like that." P3 laughs, they all relax a bit but still not fluent. As an additional inspiration, F offers creativity triggers from the walls; they brainstorm individually, and then share and discuss ideas in turn (28:38). In the end, they get caught on 'cheating' - they brainstormed actions similar to what they already tried in practice.		RM, F, VC	5	Example of VC by F, based on group structure and reactions.
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35:00	F decides not to give up on them coming up with a novel idea for care, takes the flipchart from the wall and puts it on the table; projector is removed, and suggests re-examination of their existing ideas, and combination, maybe using the creativity triggers as the criteria. To get them started F asks “what’s the worst idea you can come up with?” (pre-planned for releasing pressure), P4 “Taking them out for football and a pint”, P2 “You can actually do that, we’ve done it here, we take them for pub and things!” - lesson learned - even if something seems unfeasible, it just might be. P1 takes lead of writing down the final idea they come up with. All Ps continue reflecting on their practice, with many example cases.		RM, VC, Cu, F	5, 6, 7, 8	Use of creativity triggers for combination, rather than selection.
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46:30	Transfer from excursion: projector is back for the final page of the app, but even after they say bye to Hazel Court, Ps continue to share the stories, P1 concludes with “You always have to read between the lines”		F	/	When asked on impressions, P2 said “It makes you really think about what we’re doing, but it’s nothing we haven’t done before. It’s good that we can communicate together because some of us worked in different care homes and some of us are new staff members.”; P3 “And we should do it a bit more.” P2 “And it’s interesting, I’ve enjoyed it”
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Session 4 (07/06/2013)

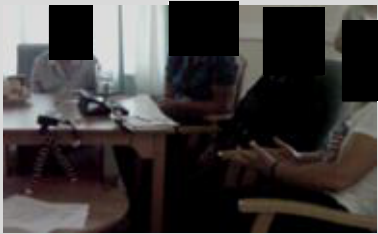
Participants: From left to right 1 younger and 3 older female carers, P1-P4; P1-P3 are employed with the organisation and work together, whilst P4 now cares for her mother at home, but also used to be a care staff member at the organisation; F - facilitator.

Total time: 01:05:42, duration of play session: 01:05:42;

Source file(s): JunSession4.mov, JunSession4_Part2.mov

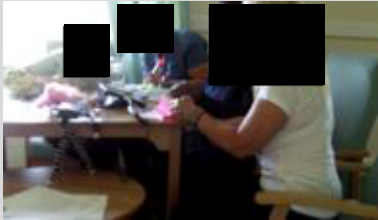
Time	Description of activity	Image	Mechanics (CGBL)	Dynamics (CGBL)	Notes
00:00	Introduction: F does the warm-up: explains the creative learning objectives of the game and the game premise, reads out the first two pages of the app, and explains how to use the app, what to pay attention to and what is going to happen along the way. F doesn't interact with the app, but encourages Ps to press Play and Next. They are all familiar with Cluedo from before.		RM	1	Climate in the room at the beginning is a bit reserved, but not negative.
04:02	Meet the Blacks: F asks Ps to take over reading out loud, P2 takes the lead. P1 and P2 briefly discuss the prompt, saying they had couples before at the home and that the Blacks sound familiar.		RM, Co, F	2	/

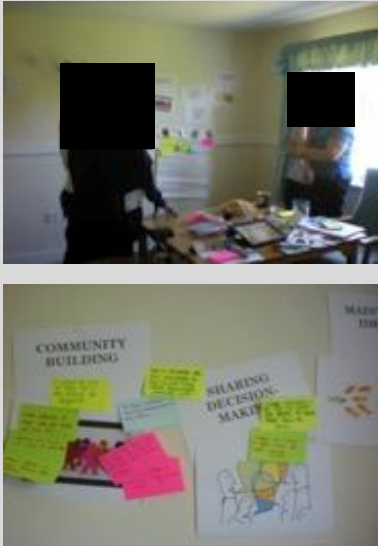
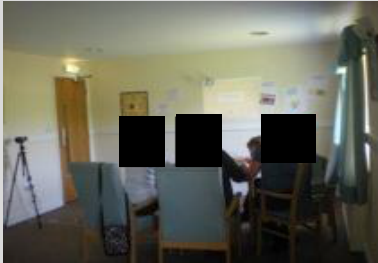
05:11	Meet the characters: F gives additional explanations, and then P2 continues with reading. They have fun exploring the character profiles and picking their roles; there are no usability problems and they often laugh. F hands out the card tokens. P4 takes a turn at operating the app, and starts taking notes.		RM, Co, Cu, F	2	Some emergent behaviour initiated by P4.
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09:47	They are on the Hall page. P4 reads out, and after brief commenting, they decide to go to Dining room next; no usability issues.		RM, VC	2	Body language of anticipation, or not being able to read clearly the font? P1 and P2 in especially good mood.
11:55	Players are in the Dining room . They easily recognise how to play the audio, and P1 and P4 discuss what Miss Scarlet said; then they find the digital clue, and discuss it as well. Climate is relaxed and they laugh to each others' speculations.		RM, Co, F	3	/
14:52	They find Col Mustard in the Library , and P4 comments on his statement, P2 joins the discussion. P1 spots the digital clue, and P2 makes a comment on its meaning.		RM, F, Co	3	Notice how the body of the language of the group is positively changing as the game goes on.

18:24	Treasure hunt introduction in the Billiard room . P2 “Do we have to pick them up?”, F reassures them to be free to pick up all they find. No emergent behaviour, but they find all the implemented clues; some laughter, they seem to enjoy it.		RM, Co, F	3	/
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20:15	Re-examining all the clues using the “whiteboard” page: F helps Ps to summarise their findings and asks them to brainstorm associations and talk about the meanings of the things they found. Ps decide to explore the digital clues first, and then the physical clues, one by one and discuss associations in a group. They need some prompting by F with examples to kick off discussion. P4 looks at the headphones and shares a story about care practice of providing elderly with Skype to stay in touch with their family; shares several more stories prompted by other clues. P2 shares some examples from her practice too, whilst P1 and P3 mostly ask questions to the other two participants, but then they also start sharing. They take their time, climate is relaxed and they spontaneously take turns to operate the app.		RM, F, VC	5	In this session they don't do simple 1-1 associations on paper, but rather the stories/experiences are shared from the practice, and the game adapts. Lengthy group discussion, mostly due to P4's initial openness?
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33:10	Combining associations into headlined ideas about Blacks' care plan changes; F introduces the process, Ps first ask for an example and then they are successful in generating headlined ideas, but combination is not successful in a designed way, because they associations weren't written down in the previous step. However, they seem to rely on the clues and the associated meanings they agreed as a group in the previous step. Climate is relaxed, they offer each other biscuits etc. They do the brainstorming individually, and then share all their ideas, using a flipchart to make an overview. In discussion, it comes out that the most of the ideas seem to be reflections of the things they have tried or heard of. They affirmatively comment on each other ideas, build on them and share associations these ideas trigger; even P3 actively joins after relatively shy for the first half of the session. P4's idea (54:40) will get implemented later at the care home, as decided by the rest of the group, as they really liked it (using a dice to choose an item for active reminiscence from a set marked 1-6 from items found in resident's room). P4 said she never tried something like that before, and that she thought of it looking at the dice at the table.	  	RM, F, Cu	5, 6	Commenting on each other ideas and building on them in parallel with sharing, and therefore adding meaning to them; emergent behaviour. Good flow of communication. An idea emerged, triggered by a pair of dice at the table, which the whole group really embraced, and they haven't tried something like that before. Ps said they will try it at the care home.
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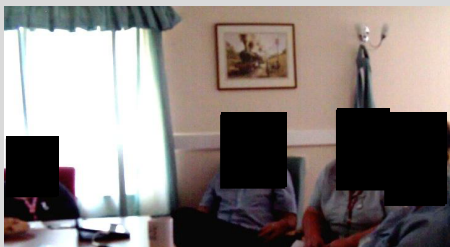
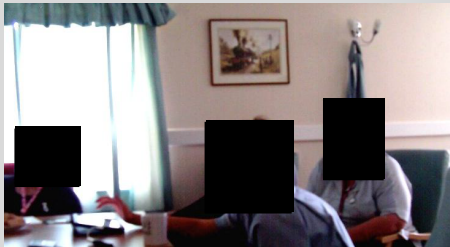
59:18	F introduces creativity triggers . Participants approach the wall and sort their ideas according to the triggers. They discuss how their ideas relate to the triggers themes and how they could be combined, so they rearrange the post-its as they talk. They continue to reflect on their practice, but on a more abstract scale, in relation with the values connected with the triggers.		RM, Cu, F	6, 7	Emergent behaviour. Atmosphere is very positive and participants engage well with the themes.
01:05:00	Transfer from excursion: Ps wrap up their discussion with summarising the potential application of what they've learned through the experience and being a "detective" in a care home and creating solutions for dementia issues.		F	/	/

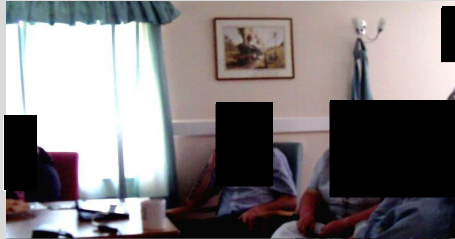
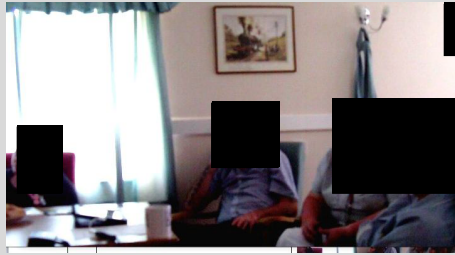
Session 6 (07/06/2013)

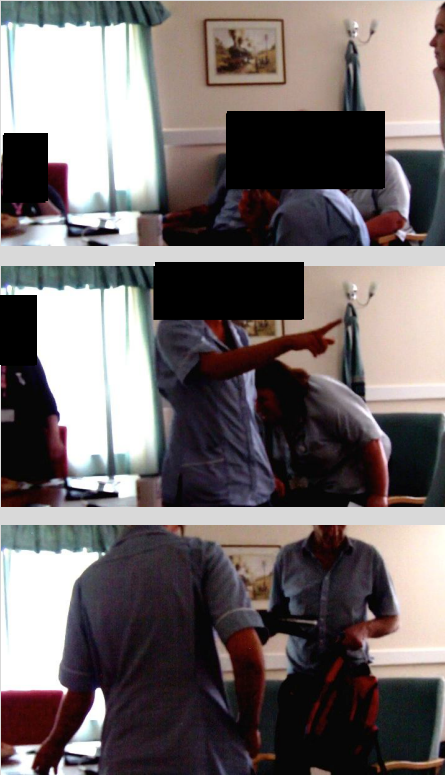
Participants: From left to right, 3 female and 1 male carer, P1-P4, P1 & P4 are younger, P2 & P3 older, all of them with 5+ years of experience in care at the organisation, F - facilitator, O1 - observer in the background;

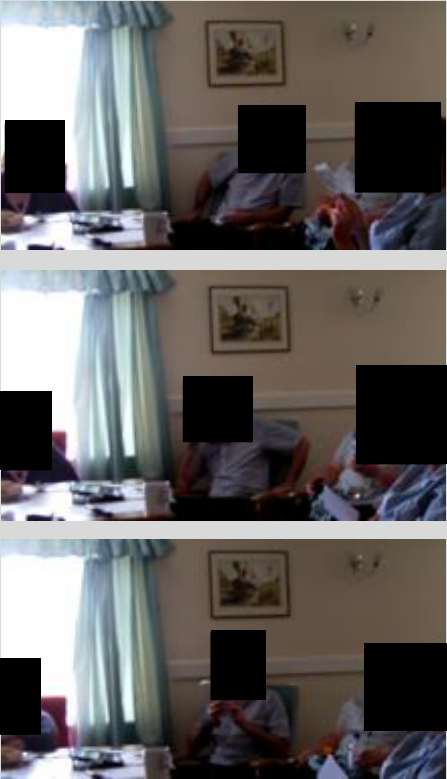
Total time: 53:46; duration of the session: unknown, as the first event is missing from the timeline;

Source file(s): JunSession6.mov

Time	Description of activity	Image	Mechanics (CGBL)	Dynamics (CGBL)	Notes
00:00	Meet the Blacks: P1 reads out loud. F asks if the Blacks sound familiar to them, P3 reflects on her experience with cases of couples they had in the home. P4 operates the app.		RM, Co, F	2	Introduction not shown on the video due to researcher's error. As in this playtesting the researcher is doing both the role of game-master and collecting data, such errors may occur. Judging by the body language, P2 and P4 seem a bit nervous and as if they don't want to be there at the training.
02:34	Meet the characters: Ps explore the characters, one by one, P2 reads aloud, while P4 operates the app. The climate in the room is still a bit reserved but at this point relaxes a bit, occasional giggles when getting to know the characters and picking the roles, but not much reflection on the contents.		RM, Co	2	/

06:19	They are on the Hall page, where the investigation begins. F provides additional explanation and introduces the challenge. P1 and P3 briefly discuss the available choices, while P2 and P4 remain mostly silent. F tries prompting them, but with no result.		RM, VC	2	Individual participant's disposition can significantly affect the aesthetics of the game play? Notice the body language throughout the session - no changes.
08:05	They are in the Dining room . They need prompting for spotting the digital clue and the audio button to activate Miss Scarlet. Only P3 comments on the contents, but they overall do not seem immersed. P4 asks "Should we click on it?" (the digital clue), but in this version there is no such function. F tries to animate Ps to discuss, but with no success.		RM, Co	3	For some other version of the game, adding an event to spotting of a digital clue could be an interesting feature?
10:38	They go to Library , where they find Col Mustard. They don't notice the audio button right away, but P4 gets it after a couple of seconds, without prompting. P1 "Can we hear it again?", and they listen again. P4 notices the digital clue without prompting too.		RM, Co	3	/

12:40	Treasure hunt introduction in the Conservatory. They collect the digital clue and P3 now spontaneously discusses its meaning in the context of the Blacks and previous clues - she built an entire scenario. P2 joins the discussion for the first time. When the treasure hunt began, P2 starts looking for clues in the researcher's suitcase, and brings her laptop and observer's backpack to the table. P3 brings researcher's water bottle to the table.		RM, Co, F, Cu, VC	3, 5	Emergent behaviour - building a story connecting all the clues together at this game stage. Spotting researcher's personal items is in its essence a good detective move because these are very personal items, which can give meaning.
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16:45	Re-examining all the clues using the “whiteboard” page: F helps Ps to summarise their findings, adapts to the ‘new’ clues such as laptop, and asks them to brainstorm associations and talk about the meanings of the things they found. Ps focus more on the physical objects in front of them, taking them one by one. P3 combines the car and water bottle she found into a scenario about the Blacks (18:10). Even P2 participates in brainstorming associations to clues; P1 seems not impressed by the exercise, F tries to get her involved “What do you think about the clues?”, P1 “I’m not sure, I’m confused”; P3 then tries to animate her to think more like a detective by telling a story from her practice of person-centred investigation, P1 eventually agree on the importance of it when thinking about introducing changes to care plans. F uses this as a natural transition to the next stage.		RM, F, Cu, VC	5, 6	The climate in the room seems to be more relaxed after the treasure hunt. Also, the curtains could be up, letting the sun in. Was interesting to see how emerging clues were used. Also, participants prompting each other and not necessarily relying on F. However, some Ps remain more difficult than others to prompt.
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24:54	Combining associations into headlined ideas about Blacks' care plan changes was attempted but Ps are not successful in generating headlined ideas, nor combining the associations, even after significant prompting and explanations. Apart from P3, who wants to tell more stories but not do brainstorming as designed (i.e. individually, writing down on post-its), everyone else just sit passively and seem not that interested in the training. P1 keeps playing with the post-its, making them into accordion. They briefly start writing ideas down, but quickly go back into talking about their practice, now P1 and P2 more actively joining in. P1 "But what's the point, you can't pay it, it's just not feasible". F then applies "imagine the ideal world" brainstorming technique, asking them to remove the constraint of feasibility or money, and that seems to get them back on track on the task of thinking of something they haven't tried before, in order to try to challenge them more and achieve some creative learning benefits.		F, Cu, VC	5	They said they had no experience with brainstorming before, and seem not interested in it either. Body language says it all here - quite opposite of targeted aesthetics. Os later inform me that this particular group was difficult on other training sessions too - and that they often complain about being overworked and underpaid to their management. F had to adapt to the difficult group with introducing another technique.
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41:52	F introduces creativity triggers. P3 again tells the stories from their practice, focusing on Sharing decision-making. F asks them to develop one of the ideas she mentions further into an activity they haven't tried before, but Ps don't cooperate. Wrapping up, F shows Transfer from excursion page from the app: not really applicable, because they haven't managed to go to the excursion fully immersed (50:17). ☺ More reflecting by P3. Ending at 52:50.		F	7	In this group, there seems to be even too much reflection and sharing, interfering negatively with the designed mechanics. They don't work as a team; P3 is doing all the work mostly, others go back to the negative disposition.
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Appendix D-1: Summative evaluation creative outcomes rating questionnaire

Dear Dementia Care Specialist,

Thank you very much for participating in this study.

My name is Anja Sisarica and I am a third-year doctoral student at City University London at its Centre for Creativity in Professional Practice. I research how we can use games to help carers learn the creativity skills they may need to improve their delivery of person-centred care. The work is supported by European Union project MIRROR, where one of our partners is Registered Nursing Home Association. I am also working closely with My Home Life and supporting the best care values this organization is promoting.

This activity will take about 15-30min of your time. On the pages ahead, you will be asked to rate the ideas produced in 13 training sessions. These sessions were held in various residential dementia care homes in Greater London area in the period March - May 2014. Participants were in groups of 4 staff members (including carers, activity organizers and managers). In various forms, they were presented information on Mr and Mrs Black, residents in a fictional care home called Hazel Court.

Participants were asked to come up with 1 activity they haven't tried before in their practice to engage with the Blacks in person-centred way, supporting one of the My Home Life themes of their choice: Maintaining identity, Sharing decision-making or Community Building. The summaries of their ideas produced for this final task are given on the pages ahead.

Please follow the instructions on the next page. Return this form when you complete it to my email address given below. Also, if you have any further questions or feedback to share, please do not hesitate to contact me:

Anja Sisarica

Email: [REDACTED]

Mobile: [REDACTED]

Office: [REDACTED]
City University London

www.creativity.city.ac.uk

www.mirror-project.eu





Informed Consent Form for Project Participants – please tick the boxes below

Project Title: Creativity support in gaming solutions for motivated reflective learning

I confirm that I have read and understand the project explanatory statement and have had the opportunity to ask questions.

☐

I understand that participation is voluntary and that I can withdraw consent at any time, without giving any reason.

☐

I consent to the feedback I give, either in written or verbal form, to be analyzed and reported as part of this project and understand that all data will be used anonymously.

☐

Name: (please print)

Signature:

Date:

Please rate each of the following 13 ideas, by marking the number on the scale below idea summaries, from 1 (not at all) to 5 (very), in terms of their originality, usefulness and person-centeredness.

Reunion at the seaside

We are going to seafront in Southend with Mr & Mrs Black, because we've found some of their friends who moved outside of London and live in Southend now. We're going to organise them a reunion and create new memories for them. When one is taken to the seaside, they usually love picking up the stones and shells – they might use to collect them. They can go back in their mind and feel that security, touch and smells. We're going in July or August, bringing along their close friends, family, and pets.

	Not at all	Less	Average	More	Very
<i>Original:</i>	1	2	3	4	5
<i>Useful:</i>	1	2	3	4	5
<i>Person-centred:</i>	1	2	3	4	5

Garden party with a beach theme

In the summer, e.g. June, we would recreate the seaside in a garden of the care home for Mr and Mrs Black and other residents. We would use easy-to-find props such as sand, water, deck chairs, bucket, spades, fans, shawls, hats and sunglasses, and play appropriate music, to immerse in the theme. We would make our garden party be a beach party for everyone to enjoy

	Not at all	Less	Average	More	Very
<i>Original:</i>	1	2	3	4	5
<i>Useful:</i>	1	2	3	4	5
<i>Person-centred:</i>	1	2	3	4	5

Making resident's family tree

We do have care plans but we don't have family trees – meaning that only resident's life history is available, and not their family history. When the family comes to visit, care staff could help them make a family tree together with the residents. It would allow us get to know them better, but also keep their memories recorded. We recently started doing memory boxes, and this family tree could be part of it. It could prolong their ability to maintain identity and it could serve as their reflection trigger.

Not at all	Less	Average	More	Very
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<i>Original:</i>	1	2	3	4	5
<i>Useful:</i>	1	2	3	4	5
<i>Person-centred:</i>	1	2	3	4	5

Wedding memory board

We would ask the family of Mr & Mrs Black to bring us their wedding photos and put them on a big board. The board could be physical, or digital, displayed on TV. We would ask the residents about their wedding day, the music that was played, what clothes they wore, what her wedding dress looked like etc. Maybe make a wedding cake too which they could cut, and make a party in a lounge for everyone to join in.

	Not at all	Less	Average	More	Very
<i>Original:</i>	1	2	3	4	5
<i>Useful:</i>	1	2	3	4	5
<i>Person-centred:</i>	1	2	3	4	5

How to maintain communication with family and friends using the Internet

To maintain Blacks' quality of life, we intend to help them stay in touch with family and friends using the Internet. Care assistant should be there to help set up the device. It can take place in a room that is private and quite, like 1950s room, or the sensory room. Best times for this activity would be weekends and evenings, because then their family/friends are more likely to have free time. We would make appointments and obtain internet access, devices and make a Skype account for the residents.

	Not at all	Less	Average	More	Very
<i>Original:</i>	1	2	3	4	5
<i>Useful:</i>	1	2	3	4	5
<i>Person-centred:</i>	1	2	3	4	5

Skyping & shopping

We want to do two things we haven't done in this care home before, which is skyping using the Internet, and taking the residents out to shopping. When requested by Mr and Mrs Black, we could organise assistance for them to get connected on the computer and talk to their family and friends in the lounge or their room, as well as to go out shopping, dressed according to the weather.

	Not at all	Less	Average	More	Very
<i>Original:</i>	1	2	3	4	5
<i>Useful:</i>	1	2	3	4	5
<i>Person-centred:</i>	1	2	3	4	5

Sunday lunch outside the care home

We would like to take Mr and Mrs Black, Mr Green and any other interested residents for a lunch at a local café or near park, outside of the care home. That is something we never tried before, and we think they would enjoy the change. We could do it on any Sunday or anniversary. It would require consideration of transport limitations, consent from relatives, booking the venue and escort staff support. Simple and effective, but we haven't thought of it before.

	Not at all	Less	Average	More	Very
<i>Original:</i>	1	2	3	4	5
<i>Useful:</i>	1	2	3	4	5
<i>Person-centred:</i>	1	2	3	4	5

Visiting family home

We would like to organise for the residents to take a trip outside the care home and visit their family home. This would be done in coordination with their family members, who would collect them from Hazel Court care home. The best time would be school or bank holiday, so that people have more free time in general. We could organise a visit to a public garden for the residents who don't have family or their family members are unavailable.

	Not at all	Less	Average	More	Very
<i>Original:</i>	1	2	3	4	5
<i>Useful:</i>	1	2	3	4	5
<i>Person-centred:</i>	1	2	3	4	5

Updating the care plan

We would like to update the care plan of Mr and Mrs Black, in collaboration with their family, friends, council and professionals. It would happen on admission or on on-going counselling basis, at Hazel Court care home, in their room or choice of home-surroundings. Updates would be made through assessment, communication with their community, professional

impact, adaptations and compromises. It could include church involvement in activities of choice and past interests (gardening, sewing, outings...).

	Not at all	Less	Average	More	Very
<i>Original:</i>	1	2	3	4	5
<i>Useful:</i>	1	2	3	4	5
<i>Person-centred:</i>	1	2	3	4	5

Sewing in the reminiscence room

We would like to assist Mrs Black in the activity of sewing, as we think that is something she might enjoy based on her profile. When she requests to do some sewing, we would take her to the reminiscence room of the care home, where we would bring the equipment and assist her when she needs.

	Not at all	Less	Average	More	Very
<i>Original:</i>	1	2	3	4	5
<i>Useful:</i>	1	2	3	4	5
<i>Person-centred:</i>	1	2	3	4	5

Knitting in the garden

We would like to take Mr and Mrs Black out to the garden together, and then engage her in knitting activity. This would take place after tea, breakfast or lunch in the care home. We would provide needles and other equipment for knitting in the garden. We think spending time outside would be beneficial for them both.

	Not at all	Less	Average	More	Very
<i>Original:</i>	1	2	3	4	5
<i>Useful:</i>	1	2	3	4	5
<i>Person-centred:</i>	1	2	3	4	5

Coach trip in the lounge

We would like to organise a pretend coach trip for Mr and Mrs Black and other residents to their favourite destinations. It would take place in the main lounge of the care home, carers

and volunteers would set the scene. It would start in the morning – 10.30am everyone is on the coach. We would make the layout of the room like in a coach and use iPads to play videos/pictures. We would have a tour guide, announcing sights on the microphone. We would play music and sing along on the coach. We could conclude the day with fish & chips dinner, if the destinations included seaside.

	Not at all	Less	Average	More	Very
<i>Original:</i>	1	2	3	4	5
<i>Useful:</i>	1	2	3	4	5
<i>Person-centred:</i>	1	2	3	4	5

Watering plants in the garden

We would like to engage Mr Black in watering the flowers and vegetables in the garden of the care home. We could arrange for this to happen depending on the weather. We concluded he would enjoy this based on his profile. Watering plants is often not too physically demanding, and it could significantly empower him.

	Not at all	Less	Average	More	Very
<i>Original:</i>	1	2	3	4	5
<i>Useful:</i>	1	2	3	4	5
<i>Person-centred:</i>	1	2	3	4	5

Appendix D-2: Hazel Court v3.0 follow-up questionnaire

Dear Carer/Activity Organiser/Care Home Manager,

Thank you very much for having participated in a Hazel Court creative game-based training in the period March-May 2014.

Completing this **follow-up questionnaire** will take **up to 15min of your time**. You will be asked to reflect and answer the questions about if, and how, Hazel Court training influenced your working life.

Please return this form when you complete it to my email address given below. Also, if you have any further questions or feedback to share, please do not hesitate to contact me:

Anja Sisarica

Email:

Mobile:

Office:

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CITY UNIVERSITY
LONDON

MIRROR

Informed Consent Form for Project Participants – please tick the boxes below

Project Title: Creativity support in gaming solutions for motivated learning

I confirm that I have read and understand the explanatory statement and have had the opportunity to ask questions.

☐

I understand that participation is voluntary and that I can withdraw consent at any time, without giving any reason.

☐

I consent to the feedback I give in written form, to be analyzed and reported as part of this project and understand that all data will be used anonymously.

☐

Name: (please print)

Signature:

Date:

- Many thanks again for your time to take part in this study!*

