CONNECTING WITH THE COUNTRYSIDE: DESIGNING LOCATION BASED GAMES TO OPTIMISE THE EXPERIENCE FOR OLDER CHILDREN IN NATURAL ENVIRONMENTS.

A thesis submitted in partial fulfilment of the requirements of the University of Brighton for the degree of Doctor of Philosophy

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August 2018
Abstract

This research considers how Location Based Mobile Games (LBMG’s) can be designed to promote an ‘optimal experience’ using flow theory as a framework; the work is directed at older children playing in natural environments to provide a challenging and topical case for the enquiry. LBMG’s have the potential to connect people to places as play spans both virtual and physical worlds. Environments can be augmented with information, entertaining media and gamified experiences that can appeal to players. LBMGs that are absolutely positioned and situated within a specific location have the most potential for immersing players within a landscape, they have been retitled ‘place-based mobile games’ (PBMGs) to make a distinction for this study. Flow theory helps to define an ideal engagement during play and the prerequisites that help to form the experience. Entering a ‘flow state’ can be considered synonymous with being in a state of immersion for games, the feeling of being ‘at one’ with the game. The primary research questions were:

- What are the prerequisites for optimising the experience of playing a PBMG?
- What are the prerequisites for optimising the experience when older children play a PBMG in a natural environment?

The experience of playing PBMG’s within a natural environment is not well understood for design. The game and the landscape require particular physical and cognitive effort to negotiate, which can threaten conditions for flow. Maintaining a flow state involves finding appropriate levels of challenge for the player and enticing them to overcome inherent trials by addressing their emotional needs. PBMGs also require divided attention across both real and virtual worlds; it is therefore also important to consider other game dimensions that can help to immerse the player in play across domains. The methodology, to address these issues, adopts a concept driven design research approach, which places the player at the centre of the enquiry through an iterative and constructive process. Design guidelines are developed through a ‘bottom up’ process, through this methodology, using participatory, mixed methods that include observational field studies, and the co-design of concept prototypes. The analysis of these detailed findings leads to broader theoretical conclusions, including a new model of flow for PBMG’s. Considering principles of interaction, to support design guidelines, also revealed how concepts of ‘feedforward’ and ‘feedback’ can work correspondingly with other prerequisites for flow, by enabling communication during the game. An ‘experience map’ for PBMG’s was also created to define game dimensions and prompt design research. New knowledge has also emerged about the child’s latent needs for this situation alongside methods developed for working with them, using characters and stories (CAS).
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Dedicated to Mum


My rock, confidante, best friend and super mum who sadly didn’t get to see this thesis finished.

Sometimes “hung by her own façade” and very much missed.
Acknowledgements

I would like to express my sincere gratitude to my first supervisor, Lyn Pemberton, for her patience, moral support, friendship and extreme bravery in proofreading this tome of a thesis for me. She was the best advisor possible and offered positive solutions and an intelligent perspective throughout. I would also like to thank my second supervisors, Richard Morris and Nick Gant for their creative thinking, wise suggestions and the benefit of their knowledge. All three of my supervisors were incredibly supportive over a difficult time for me, during my mum’s illness.

I am also particularly grateful to Kate Howland at the University of Sussex, for her creative input and support during the design research for this project, I am not sure how I would have coped without her. I also need to thank my Product Design colleagues, Steven Smith, Eddy Elton, Des Covill, Tim Katz and Damon Taylor for their support during this time.

This study would not have been possible without the financial support of the School of CEM, University of Brighton, in paying my fees. I would particularly like to express my appreciation to Miltos Petridis, whose generous nature towards a 0.2 member of staff allowed this to happen and to John Taylor for allowing the funding to continue.

I want to thank my family and, in particular, my daughter who has to put up with a very busy mum with divided attention at times. She was also helpful in sourcing recruits for testing games and offering suggestions for location-based games. My family also offered considerable moral and sometimes financial support. My mum has always been my rock and confidante, my father has always taken a keen interest in my studies and offered excellent suggestions and my sister is always there when I need her. I would also like to recognize my friends, who have largely remained friends, despite me being very boring while working too hard, at times, particularly Jo and Vicky.

I would like to thank those who allowed me to conduct investigations, including teachers at St Andrews School in Hove and Fairlight School in Brighton. Also, employees of MindCandy, a games company who shared their excellent first-hand experience of developing games for children and the staff at AiRS Sussex, who provided excellent advice about working with children.
Preface

“No one will protect what they do not first care about.”

David Attenborough, 2010.

One morning, about four years before this thesis was written, my daughter suddenly jumped out of bed, in the early morning and announced she “was going for a jog”. This had never happened before, so I was intrigued to find out what had caused this sudden enthusiasm for exercise; as she still wasn’t allowed to roam the streets alone, I jogged lightly by her side, barely keeping up. When we got to our destination she revealed that the urgent mission was all because of a rare ‘Pokemon’, situated enticingly in our local park. So, it seemed that she and most of her friends had caught the ‘Pokemon Go!’ bug and were obsessed with catching and collecting small 3D animated creatures.

At the time, this was excellent news for me because, in the early days of research, I was somewhat fed up with repeatedly trying to explain to inquirers what a ‘location-based game’ was, only for sceptics to tell me that this kind of game would never catch on. Pokemon Go! turned out to be an extremely popular location-based game, with millions of children and adults world-wide, however, it would have been premature to say: ‘I told you so’. The digital games I had in mind would be designed to connect people with places, but Pokemon Go! players were so engrossed in the activity that they had been known to fall into streams or wander onto train tracks, oblivious of where they were.

After experience of volunteering for Sussex Wildlife Trust, I was particularly hoping to improve the relationship between older children and wild spaces, a connection that has been in decline and even given a label: ‘nature deficit disorder’. Having seen, at first hand, the excitement caused by playing an absorbing location-based game I became even more determined to identify the qualities that had engaged so many people and yet had still to establish how the player could maintain their connection with the real world and become immersed in their surroundings. This thesis is a response to this conundrum, studied from the perspective of the player and their emotional and latent needs.
Declaration

I declare that the research contained in this thesis, unless otherwise formally indicated within the text, is the original work of the author. The thesis has not been previously submitted to this or any other university for a degree and does not incorporate any material already submitted for a degree.

Signed

Dated
1.1 Introduction

The primary aim when conducting this research was to investigate the potential for location-based mobile games (LBMGs) to connect people with places, and to consider how the experience of play can be optimised. The possibility for these games to increase engagement with a landscape was explored through a case study of older children, aged 8 to 13 years, playing outdoors in natural environments. Choosing this situation of play addresses a topical real-world problem, an identified disconnect between young people and nature; it also provides a challenging situation for the study, due to the physical and cognitive demands involved in negotiating the terrain. A typical example of terrain used for this project is shown in Figure 1-1.

Figure 1-1: PBMG activity in a natural environment during this study

LBMGs require play across both physical and virtual spaces. Physical proximity is the primary link we have to experiencing place and geographical position tends to increase information flow about a location as well as interest in it (Ritchie, 2014). These games could, therefore, introduce people to a new landscape, increase their engagement with an environment and help them to learn through the experience (Nova, 2009; Sharples, 2010). The games found to be most appropriate for this purpose were a subset of LBMGs that are absolutely positioned and situated within a specific location. They have been retitled ‘place-based mobile games’ (PBMGs) for simplicity and to make a distinction for this study. The ‘experience of play’ will inevitably be dictated by both pragmatic usability concerns (the game should be playable) and affective emotional responses (the game should be engaging). Theoretical frameworks that relate to
Chapter 1: Introduction to the Thesis

an ideal experience, allowing a diverse perspective, such as flow theory, introduced by Csikszentmihalyi (2002), therefore have the potential to support game designers in modelling preferred game qualities. Principles of interaction originally introduced by Norman (2005) and Shneiderman (2004), were developed to inform the design of meaningful relationships between people and technology and have the potential to provide detailed guidelines for designers that can complement a broader theoretical framework. Research for this thesis also considers how they are able to inform relationships between people, technology and place, thus, broader design frameworks and more specific design principles were explored during this research. However, relying on theory to design for a specific application (PBMGs) is no longer considered a sufficiently thorough or empathic way to gain perspective for a given problem. Contemporary methodologies that allow the designer to work more closely with stakeholders, particularly, in this case, the potential player, allow a deeper understanding that can lead to more appropriate solutions.

Consequently, this thesis describes how the theories were chosen, applied and adapted for PBMG’s, explored through the case of older children and nature. The study adopted a participatory approach that included the user and nature expert in the design process, through a ‘concept-driven’ design research methodology (Stolterman, 2010). This supported the identification of appropriate levels of challenge and the emotional needs of the player when attempting to overcome such challenges. The research resulted in the production of a new, specific model of flow for PBMGs that applies to any scenario and a set of design guidelines that support the design of games for this particular scenario and others. New user research and co-design methods were uncovered along the way.

The objectives for this chapter are to:

- Provide a rationale, including background information and personal motivation for the research.
- Define the aims of the project and research questions.
- Describe how they will be achieved, through the concept-driven design research methodology followed.
- Describe the contributions to research.
- Provide an outline of the thesis.
Chapter 1: Introduction to the Thesis

1.2 Rationale

The following defends the decisions made when investigating the chosen research questions.

1.2.1 Why location-based mobile games?

To explain why location based mobile games were chosen for this research, it is necessary to explain their basic features and why they have emerged as a genre.

1.2.1.1 Explaining LBMGs

An LBMG is usually played on a mobile device, requires movement around a physical space during play and connects to a virtual space, delivered through an interface. The player seeks a particular location and, on arrival, the next piece of information or activity is revealed (Avouris, 2012)

![Figure 1-2: Map for navigating ‘Snowdogs by the Sea’](image)

Most LBMGs feature a map, annotated with GPS locations, that can serve to illustrate the connection between worlds. ‘Snow-dogs by the Sea,’ shown in Figure 1-2, provides an example. Developed for The Martlet’s charity (Wild, 2016) it had participants seek out 3D sculptures around the streets of Brighton and interact with them upon finding them.

LBMGs have proven to be popular with both children and adults. Recent
examples, at the time of writing, include ‘Pokemon Go!’ and ‘Ingress’ (Harmston, 2016) with millions of followers, suggesting they can be enjoyable. However, commercially successful games have so far not been focused on understanding or engaging with the environment around the player.

The work in this thesis attempts to bridge this gap by considering the dimensions of PBGMs that contribute to an enjoyable experience, targeting both the pragmatic and emotional needs of the player, but also including a connection to place, which also allows a degree of informal experiential learning.

1.2.1.2 The emergence of LBMGs
Mobile phones and tablets have enabled interaction with information wherever and whenever we require. Location aware technologies, combined with this mobility, allow direct association of our interactions with a given location so that they can be ‘context aware’ (Sharples, 2010). Contextual awareness is now part of our normal experience; with a mobile device in hand, we can take photos of holiday moments and record their location, tag a good venue for others to visit or view the whole planet as if on a spaceship. Awareness of location has also been used for more serious applications, such as rescuing people in difficulty up a mountain, environmental and atmospheric monitoring, animal behaviour studies, botanical specimen locations and climate research (Locata, 2016). When contextual awareness is combined with the use of other features that can introduce a range of media, photography, video, Augmented Reality (AR) and different forms of interaction, the potential for enjoyable engagement with the physical world is greatly enhanced. This potential led to the emergence of LBMGs. In 2003, following the introduction of global positioning system (GPS) on mobile phones, ‘Mogi’ was launched in Japan, this was a multi-player game where individuals, or teams hunt down virtual treasures hidden in Tokyo. This represented one of the first commercial examples of an LBMB (Joffe, 2005), therefore, in 2018, the time of writing this thesis, LBMGs are still considered a relatively new form of game.

1.2.1.3 The motivational effect of games and screens
People are drawn to screens and information devices in general, according to the
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National Endowment for Science, Technology and the Arts (NESTA) organisation (Kirriemuir, 2004). Computer games are particularly enticing for young people; the European survey, ‘Gametrack’, conducted by the Interactive Software Federation of Europe, shows that 77% of children, aged between 11 and 14, play computer games (ISFE, 2016).

Game-designer Celia Pearce discusses the following relevant attributes of a game: having a goal, resources, rewards, penalties and information. All of these can contribute to motivation during play because they appeal to our basic psychology (Pearce, 2011). Media content, social situations and other parameters have also been identified as contributing towards enjoyment (Denham, 2004).

Jane McGonigal, a researcher and games professional, asserts that the popularity of role playing games, such as World of Warcraft, can be due to players being able to achieve more than in reality, including having “super-powers”, and allowing them to successfully “save fantasy worlds” (McGonigal, 2010; McGonigal, 2011). She asks the question: “what if we could harness ‘gamer power’ to solve real-world problems?” (McGonigal, 2010). In theory, the desire to ‘save’ virtual fantasy worlds could be superimposed upon our real, physical environment and help raise an awareness of it.

The Byron Review, commissioned by Gordon Brown, recognised the motivational properties of games for learning and suggests that there is a need for a focus on the different types of games and their properties:

“in order for research to be informative for policy, it needs to break down and begin to understand the nuances of games […] which will all potentially have a bearing on the game’s impact and usefulness” (Byron, 2008).

This research considers how the LBG game genre can be adapted to meet the particular challenges of the problem under investigation, engaging people with a landscape and optimising experiential learning.
1.2.1.4 Taking screens outdoors

Though certain researchers discuss the positive effects of games, others point to the fact that screen-based activity can distract people from the real physical world (Kirriemuir, 2004; Bond, 2012). A stark illustration of the problems with game addiction is provided by Parkin, who discusses the detrimental effects games can have on health and wellbeing when we neglect other areas of our lives (Parkin, 2015).

To move away from indoor screens, there have been attempts to leverage the motivational qualities of technical devices, taking them outdoors for situated learning. Early researchers into learning, including Piaget (Piaget, 1983) and Dewey (cited in Alexander (Alexander, 1998)), described the importance of direct experiential learning, and their studies continue to have relevance today. Mobile learning through situated experiences was, therefore, a natural progression (Montola, 2009).

The technology used for such projects can vary. The Ambient Wood project, (Rogers, 2010) investigated the use of situated devices to create an interface between children and nature. Examples were a novel periscope to view the landscape (Wilde, 2003) and an ‘ambient horn’, a device designed to emit audio sounds representing ecological processes; these were all bespoke, embedded devices in the landscape. Other examples of technologies used for research include near-field communication (NFC) and positioned 2D barcodes, which also require an embedded physical object to activate any interaction (Chipman, 2006).

For the aims of this project, however, it was concluded that a ‘hybrid’ game should be considered, which emphasizes fun and an enjoyable experience, over secondary learning that happens informally through being in the environment. To create a connection with place (in this context, the natural landscape) a desire to play the game, in context, was considered paramount.

A range of alternatives to mobile devices were considered for the project described in this thesis, but they were eliminated at an early stage. Interviews with Sussex Wildlife Trust members who work in wildlife reserves and Nicola Yuin, an
academic and representative of the Stanmer Park Preservation society, made it clear that physical objects, even barcodes or digital tags, added to a natural environment would not be appropriate. Experts on nature felt that this could interfere with natural processes and impact on wildlife, besides being potentially visually intrusive.

Using existing mobile devices provides accessibility for a wide audience outside of the classroom because they are owned by many households. In a report by Nielsen, over 70% of the population owned a GPS-enabled phone (Nielsen, 2015). According to Hsiao et al. (Hsiao, 2010), mobile technology, with GPS and other location services, can successfully be used to enhance everyday experiences widely and successfully due to the popularity it enjoys. Mobile phones also have associations with being ‘grown up’, which are strongly attractive for children of this age (Rieger, 1997), also adding the kind of flexibility that a youngster developing independence and individuality is likely to find enticing (Luckin, 2005).

**Further information found in the Literature Review:**
Evidence discussed in this section supported the rationale that LBMGs, using existing devices and location services, were the preferred avenue for investigation for this study. Further reasoning towards the use of LBMG’s, particularly situated and absolutely positioned games, relabelled ‘Place Based Mobile Games’ (PBMGs), is provided in the literature review, section Chapter 2.2. Game design principles are also considered, along with research that helps define the properties and dimensions of games that encapsulate the play experience.

1.2.2 Why nature and children?

In order to defend the case chosen, it is necessary to describe why it is particularly challenging and why this is a topical and important subject area.

1.2.2.1 A challenging case

Understanding requirements across different applications and contexts is part of the maturation of a research field and an emergent need for this activity (Ejsing-Duun, 2011). Studies of LBMGs that focus on the experience of play for ‘hybrid’
games, offering both entertainment and a connection with place, have largely been situated in urban environments (Avouris, 2012). A series of mobile learning projects have been created to investigate natural phenomena; however, there is a focus on learning, rather than the emotional needs of the player (Wilde, 2003; Brown, 2010; Rogers, 2010; Eliasson, 2013). The principles of designing enjoyable LBMGs for a natural environment are, therefore, not well understood. Natural terrain can be tougher to navigate from a cognitive and physical perspective, compared with most built up areas: there is an absence of named streets or structures that provide landmarks and paths can be more undulating, slippery or overgrown. This adds further effort which can compromise the experience, thus providing a suitable challenge for this work. Comparing the map of a typical natural area in Figure 1-3 with the previous map for ‘Snow-dogs’ in Figure 1-2, illustrates that there are relatively few marked routes, one of the practical problems of finding locations in natural terrain.

![Figure 1-3: Google Map of Stanmer Park](image)

### 1.2.2.2 A real-world problem

Another argument for choosing this context of play is that a design problem worth pursuing should address a real-world issue. In this case, the topical theme of ‘nature deficit disorder’ is considered. This is a term originally coined by Richard Louv to describe a growing dislocation between children and nature (Louv, 2005). An article in the Guardian newspaper in 2016 ran with the title: “Three quarters of UK children spend less time outdoors than prison inmates” (Carrington, 2016). The article describes a survey carried out by Unilever, as part of their “Dirt is Good” campaign, directed by Sir Ken Robinson, a leading educationalist. The results reveal the extent to which children play in parks, woods and fields.
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parents of 5 to 12-year olds were questioned, and it was found that 74% of children spent less than 60 minutes outdoors daily while prisoners must legally spend at least one-hour exercising in the open air. Although this is a headline designed to draw attention, it is also intended to raise this as a significant issue to a wider audience. In 2012, Stephen Moss created an extensive literature review entitled ‘Natural Childhood’, for the National Trust, highlighting how today’s generation of children are losing touch with the outdoors and the natural world (Moss, 2012).

In principle, situating a PBMG in a typical natural environment has the potential to promote a player’s interaction with the natural features encountered and to counter this unfortunate trend, provided that certain emotional needs are met during the game and an engaging experience is created.

1.2.2.3 Benefits to society of outdoor play in nature

“Children are disappearing from the outdoors at a rate that would make the top of any conservationist's list of endangered species if they were any other member of the animal kingdom” (Gill, 2011).

Gill, the author of the above quote, was asked to report to the Sustainable Development Commission (SDC) on the relationship that children have with nature. In the report, the benefits to physical and mental health, behaviour, education and to environmental awareness when being in nature were confirmed (Gill, 2011). Thus, there are many reasons why we may as a society wish to counteract ‘nature deficit disorder’. Conservation bodies such as Natural England and Sussex Wildlife Trust (SWT) also argue that situated engagement within the countryside leads to greater awareness of the need to preserve it (Natural England, 2009; SWT, 2013). According to the Natural England Report, visiting the countryside at an ‘impressionable’ age leads to a lifetime habit of returning and enjoying it. The years between 8 and 13 have been identified as important as they are when children are becoming more independent, forming their own opinions or identity, and importantly it is when habits are formed (Bateson, 2013). Older children within this range are therefore considered appropriate subjects for this research in natural environments.
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Further information and the Literature Review

The reasons for a disconnect with nature are discussed in more detail in literature review section Chapter 2.3, ‘Context of Play’, including issues of proximity and culture, carer safety concerns and notably the fears or preferences of the children themselves. Further information on how experts entice young people to engage in a landscape and overcome such fears and cultural constraints, is also included along with facts about physical, cognitive and emotional development for this age.

1.2.3 Ideal experiences, flow and LBMGs

To entice people to engage with the physical and virtual world that the PBMG represents, the game must represent an enjoyable experience. Dewey separated everyday experience from a special 'experience', which has a clear beginning, an end and will be memorable (Dewey, 1938). Norman also makes a distinction between everyday experiences, which may not be remembered and special 'optimal' ones that are more likely to form a lasting memory (Norman, 2013). When reviewing definitions of an 'optimal experience', Fave concluded that “A large number of studies (..) show that optimal experience is a positive and complex condition in which cognitive, motivational and emotional components coexist in a coherent and articulated reciprocal integration” (Fave, 2009). The factors that help to form an optimal experience are central to the thinking behind flow theory (Csikszentmihalyi, 1990). Other potential theoretical frameworks vary from the use of ‘transportation’, ‘disposition’, ‘attitude’, to ‘para-social interaction’ theory (Oliver, 2004). Transportation theory combines the study of attention with imagery and feelings to define the enjoyment of games (Green, 2002). The theory of disposition relates positive and negative attitudes towards different media (Raney 2004). Attitude describes a tendency to evaluate an entity with a degree of favour (Nabi, 2004). Para-social interaction is when a player forms an attachment to the media and further imagines the life of the character. However, Sweetser and Wyeth suggest that these alternative frameworks offer a relatively narrow perspective, and that flow theory provides an ideal base to build a tool for analysis because it is broader and takes a wide range of elements into account (Sweetser & Wyeth, 2005).
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Being in a state of flow has been described as “the state in which people are so involved in an activity that nothing else seems to matter” (Csikszentmihalyi, 1990). Though this can apply to many situations from playing music to painting, the structure provided by games can also help people to structure their consciousness to achieve a flow state (Csikszentmihalyi, 2002). A state of flow is encountered when a variety of factors are met and is characterised by a high-level of focus, motivation and immersion in an activity.

Researchers have acknowledged a natural link between flow and games (Sweetser & Wyeth, 2005; Chen, 2007; Jegers, 2007; Murphy, 2013). Game experts have previously redefined the prerequisites for flow to include: an appropriate level of challenge, feelings of control, clear goals, focused concentration, feedback and a feeling of immersion (Sweetser & Wyeth, 2005; Murphy, 2013). These categories are illustrated in Figure 1-4.

![Figure 1-4: Previously-established flow model across all game genres (Sweetser, 2005)](image)

For this study, flow potentially provides a useful framework to consider enjoyment and immersion through the properties of a game, forming an *ideal* that can be worked towards. This research therefore evaluates and proposes a new model of Flow, specifically to explore the experience of PBMG’s for a hybrid game, where fun is most important, but informal experiential learning also occurs during play. The model also serves as a framework to classify design guidelines and subsequently can be used as a tool to support the work of game designers and researchers for this genre. However, there are particular challenges to a flow
Chapter 1: Introduction to the Thesis

state, inherent in PBMGs. Immersion is required across both virtual and physical worlds although attention is divided between them and playing across domains requires a certain level of challenge. This study attempts to study how to overcome such difficulties in order to creating immersive games that provoke a flow state as far as is possible.

1.2.3.1 Flow and levels of challenge

Appropriate levels of challenge are critical to an optimal experience. For PBMGs, where the player must negotiate physical terrain, and concentration is divided across physical and virtual dimensions, levels of challenge are high and the player’s sense of control may easily be overturned (Nova, 2009; Ejsing-Duun, 2011; Ritchie, 2014). It is suggested that people choose to play games as a “voluntary attempt to overcome unnecessary obstacles” (Suits, 2005) and that they actively seek this challenge. McGonigal (2011) claims that in games, players feel more powerful, have more impact and can be ‘more than themselves’, and this is what motivates them to overcome such challenges. It has been suggested that the answer to why we take on these challenges lies in the emotional experiences a game affords (Yannakakis, 2010).

There are two possible approaches to designing appropriate levels of challenge within the game that define the experience:

1. Ensure levels of challenge do not exceed the abilities of the audience and superfluous effort is minimised.
2. Increase volition and enticement to overcome challenges by targeting and addressing the emotional needs of the player.

For the first approach, to optimise flow, the demands of the game, including the physical environment of the LBMGs, need to be evaluated against the skills and abilities of the player so that they are practically able to address them. For this, an understanding of the developmental stage of the child and their specific requirements is required. Principles of interaction can also help to optimise the different levels of cognitive challenge (Norman, 2013). For the second approach, the will of the player to overcome challenge depends on how the game meets their affective needs. Immersyve are a research group that provide a framework
for improving motivation for games, backed by 40 years of study, called Player Experience of Needs (PENS) (Rigby & Ryan, 2011). They conclude that meeting key emotional needs is pivotal to game engagement. Other game researchers (Freeman, 2003; Bateman, 2008; Arelius, 2013) also demonstrated a correlation.

Further Information and the Literature Review

- Flow theory is evaluated against a series of other potential frameworks in Chapter 2.4. Interaction Principles are also described in more detail along with their relevance to this study and how they may support the flow framework.
- The emotional needs of the player, which can support the desire to overcome challenges are expanded upon in Chapter 2.2.
- The increased level of challenge when managing this terrain and how the developmental stage of the child relates to it is discussed in the Context of Play, Chapter 2.3.

1.3 Personal Motivation

For two years, before the instigation of this PhD, I was a volunteer for the Sussex Wildlife Trust (SWT) helping to run holiday club activities for children. The SWT is one of the leading UK organisations involved with nature conservation. A key element of their work is communicating to young people the importance of the countryside and the biodiversity within it. While volunteering for one of their Sussex-branch holiday activity groups, an issue with older children was raised, which inspired me to explore it further. Despite the activities being open to a wider age group, 85% of the attendees are usually aged between 5 and 8 years old, with older children being notably absent. Kate Tiffin, the children’s activity coordinator for the Sussex Wildlife Trust until 2013, stated in an unstructured interview that children over the age of 8 were more reluctant to participate in outdoor activities than their younger counterparts. This has been described as ‘nature deficit disorder’ by theorists. This experience inspired me to use this situation as a case study for this research since it also provides a suitably challenging environment for the application of PBMGs.
1.4 Project Aims and Research Questions

1.4.1 Primary aim of the research

- To understand how the properties of PBMGs contribute towards promoting an optimal experience, where a connection with the landscape is significant.

1.4.2 Research questions

The primary research question is:

- What are the prerequisites for optimising the experience of playing a PBMG?

Interpreted for this particular case as:

- What are the prerequisites for optimising the experience when older children play a PBMG in a natural environment?

1.4.3 Subsidiary aims

More detailed aims for the research are to:

- Develop a new theoretical framework specifically for PBMGs to support the design of an ideal experience during play.
- Identify appropriate levels of challenge for PBMGs and consider how challenge can be optimized through interaction design principles.
- Recognise key emotional needs that can encourage the player to overcome inherent challenges for PBMGs.
- Develop a series of design guidelines that can support the development of engaging PBMGs for older children, playing in a natural environment (specific to this case study).
- Infer, from the case study, generally applicable design guidelines that can apply to any PBMP game scenario.
- Create an ‘experience map’ that can prompt relevant issues to be investigated to support the design research process for others developing PBMGs.

The aims are further divided into a series of research issues that emerged through the literature review and during design research phases of the project.
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1.5 Project Aims and Design Research Approach

The following sections describe the particular approach taken to design research for this study and why it is appropriate.

1.5.1 Wicked problems and design research

Designing PBMGs that can connect people with a place can be considered a real-world concern, which could be described as a wicked problem. Originally defined by Rittel, Webber and Melvin (Rittel et al., 1973), a wicked problem is a set of interlocking issues and constraints, embedded in a social context with the following characteristics:

- Formulating the problem and the solution are essentially the same. Each attempt at creating a solution changes the problem understanding.
- Various stakeholders will have differing views of acceptable solutions.
- The appropriate way to tackle wicked problems is to work with them. A consensus emerges through the process of laying out alternative understandings, competing interests, priorities and constraints.

Buchanan refers to wicked problems in design thinking as being able to address complex human concerns through a process of identifying or ‘tying down’ design attributes to meet the needs of the situation (Buchanan, 1992). It points to a design process in which an initially large and diverse set of considerations can be systematically narrowed as particular requirements or specifications are identified. Dick Powell, founder of Seymour Powell, described the design process as ‘an explosion in reverse, a slow congealing of chaos, which accelerates at the last to snap into something unbroken and defined’. As such, proposed solutions remain open until sufficient information has been gathered to fully understand the problem (Burke, 1995). In sum, for design research, the initial gathering of information is often broader in scope than for other research fields but is then narrowed down into a coherent set of design guidelines.

Each stage of this investigation is represented in the descending series of rectangles shown in Figure 1-5. The level of information being investigated is represented graphically by the size of each rectangle.
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Figure 1-5: Narrowing of the research issues as attributes are ‘tied down’. The blocks represent volume of information.

1.5.2 Concept-driven design research

According to Reeves (2006), the primary features of design research are: the identification of real problems; the creation of prototype solutions based on existing design principles; and the testing and refinement of the prototype solutions and design principles until satisfactory outcomes are reached. However, a ‘concept-driven’ design research process focuses on theoretical contributions through a range of smaller, conceptual prototypes to investigate specific attributes and provide control conditions, rather than working towards a singular design solution. The concept-driven design research methodology has much in common with other ‘design-thinking’ processes (Zimmerman, 2007) as it proceeds through a series of stages, defined by Stanford University as: empathise, define, ideate, prototype and test (Plattner, 2006). This is a relevant approach since a key research contribution is a set of design guidelines for PBMGs that help to specify a desired experience, a theoretical outcome that has so far not been explored in previous research, particularly for this scenario of play. It is also iterative and participatory in its nature, terms which will be defined next.

1.5.2.1 An iterative approach

Following the testing of prototypes and ideas, an analysis of the evidence is followed by the evolution of new ideas, allowing further conjecture and design.
This suggests an iterative approach from one phase to another, which provides an appropriate way to check findings and validate data. The design experiment cycle was developed by Mor (2010) and illustrates the iterative nature of the approach required, as seen in Figure 1-6.

Outcomes, according to Mor (2010), may be design knowledge, theoretical contributions, designed objects, examples of practice or research instruments.

**In this study the outcomes can be described as:**

- Concept prototypes (useful artefacts).
- Design guidelines (design knowledge) as attributes of the problem are ‘tamed’.
- A flow framework for PBMGs informed by the ‘bottom-up’ process to identify the guidelines (a theoretical outcome).
- An experience map to support the design research process (a research instrument).
- New methods to investigate the latent and emotional needs of the players (research instruments).

These outcomes can be illustrated through an adaptation of the Mor (2010) model, through two simpler categories, design knowledge that can inform the properties of PBMGs and design tools and methods that can inform the design process, in Figure 1-7.
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1.5.2.2 A participatory approach

Gaver (1999), the co-inventor of Cultural Probes, states that "designing for pleasure demands a different approach from designing for utility. The latter can be done from outside a given situation, standing back to assess difficulties and seek solutions. The former, in contrast, is better done from within" (Gaver, 1999). This points to a participatory approach, in this case involving children. To achieve the aims of this project, it is necessary to consider both the tacit and latent needs of the child. Thus, the investigation proceeds through a process which also develops new approaches to participatory research, analysis and design for the older children that can assure rich data. The methods of investigation chosen were also cross checked using a framework known as ‘Say, Do, Make (Think)’, introduced by Sanders (2002) to enrich the findings and understand latent needs. In simple terms, the system involves finding out what the users say about themselves, watching what they do and making designs with them to predict their future needs, in parallel.

Further Information and the Literature Review

Chapter 3 discusses the development of the concept-driven design methodology in more detail, setting out the rationale, the methods applicable to children and how an experience map is developed to guide the investigation.
1.6 Outline of the Thesis

The following describes the main sections of the thesis and how they address the research questions.

Chapter 2: literature review

To gain a solid understanding of the problem and data from a broad range of studies, a literature review was carried out. This chapter focuses on three main areas, shown in Figure 1-8, and categorised as follows:

Chapter 2.2: Location Based Games and Game Design

This section is about ‘conceptualising’ LBMGs, their properties and game design principles generally (shown in red in Figure 1-8).

Chapter 2.3: Children, Nature and the Context of Play

The context for a design, who, what, when and where: this involves ‘contextualising’ where the game will be played and understanding the player (shown in green in Figure 1-8).

Chapter 2.4: Theoretical frameworks

Theories that support the design of an ideal experience. This includes a consideration of how flow theory is appropriate and interaction principles that can provide a foundation for implementing ideas (shown in blue, Figure 1-8).
Chapter 2.5: Literature Review Conclusions

Evidence from all three areas of study is analysed and a set of preliminary design guidelines gathered, which will be further investigated for the validity of the PBMGs during the design research phases. The literature helped to raise key issues to frame the design research investigation.

Chapter 3: Developing the Methodology

This chapter presents literature that was supportive in the development of the concept-driven design research methodology. Research on mapping an experience was also studied to establish a newly developed version specific to the investigation of PBMGs, to ensure significant dimensions were considered. Literature related to supportive techniques to ensure data was effectively cross checked, such as ‘Say, Do, Make, Think’, are discussed alongside the selection and development of appropriate methods.

Chapter 4: Design investigation

This chapter describes the procedures followed when applying selected methods and the sequence of activities that followed. This has been categorised into phases of investigation, from ‘framing the problem’ to the ‘final prototype’, with a discussion of results after each stage. This is because each phase builds on the previous one and tests the findings.

Chapter 5: Analysis of Results

The results of the design research are analysed in Chapter 5, with a summary of the final research outcomes, including a final set of tested design guidelines, the resulting flow framework for PBMG’s and conclusions about the methodology are also discussed.

Chapter 6: Conclusions

Conclusions about this work, how the research has answered the research questions and suggestions for potential areas for future study are covered in Chapter 6.
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1.7 Contributions to Research

The diagram in Figure 1-9 represents the main research outcomes, in relation to the three areas of study that were considered. Where the areas of knowledge overlap in the diagram, research outcomes for this project are indicated as a result of the design-based research process. The outcomes and how they represent these areas will be further described in the following sections.

![Diagram](image)

**Figure 1-9: Outcomes related to the areas of study**

1.7.1 Designed artefacts

Tangible design outcomes of the design research process include a range of concept prototype ‘demo’ games, created by children with associated media assets for a natural park area (mostly situated in Stanmer Park, Brighton, UK). More developed prototypes were also created, combining elements of the children’s ideas to test key attributes. Although they are all ‘concept' prototypes, they demonstrate particular game properties that were created or evaluated with children. The game examples may provide useful material for researchers interested in designing LBMGs for young people or nature experts interested in digital applications to promote natural environments, shown in Figure 1-10.
1.7.2 Flow model for PBMGs

A primary contribution to theoretical knowledge is a revised flow framework for PBMGs that will be valid for any situation of play. This helps to predict the pre-requisites for an optimal experience to help game developers predict the engaging qualities of a PBMG game design. This was created through a detailed consideration of the case being studied, however the result is independent of the context of play and represents a theoretical outcome about games. This is illustrated diagrammatically by the purple-shaded area representing the overlap between these two subject areas in Figure 1-11.

1.7.3 Design guidelines

The design research process led to the emergence of a set of design guidelines, for PBMGs, which can be interpreted as pre-requisites for an ideal experience and achieving a ‘flow state’. They were instrumental in building the ‘Flow model.’ This work builds on general location-based game (LBG) design guidelines created by previous researchers. Some are context specific, and others are generally applicable to other situations, as described below.

1.7.3.1 Design guidelines: PBMGs in context

Some of the design guidelines that emerged relate specifically to PBMGs and children playing in natural environments. Results for this specific case were also
outlined in a conference paper (Grundy, 2014). During the process, a body of information is also created that relates to the child and their physical and cognitive abilities for PBMGs within this environment. These research outcomes require consideration of all three areas of study and are represented by the grey area in the centre of the diagram in Figure 1-10.

1.7.3.2 Design guidelines: PBMGs for any situation

Design guidelines are also created for any application of PBMGs, applicable to any situation of play. This results from considering the properties of LBMGs that relate to place and theoretical principles, applied through design research, illustrated diagrammatically by the purple-shaded area representing the overlap between the two areas in Figure 1-11.

1.7.4 Body of research: non-digital games outdoors

Conclusions have been reached that may be useful for designing any outdoor activity, rather than being specifically directed at PBMGs. During the process of studying and working alongside children in outdoor natural spaces, observations about a child’s preferences or emotional needs and the properties of the natural environment have been made that can be relevant to those interested in education, related to nature or biodiversity. Useful findings have also been identified about navigating in such environments, and what might motivate children, draw their attention or interest. Research outcomes that are independent of the PB MG and game are represented diagrammatically by the overlap of theoretical principles and the context of play, shown in Figure 1-12 in the turquoise, hatched area.

1.7.5 Methodology related Outcomes

1.7.5.1 Experience map

To support the investigation process, design researchers have attempted to model an ‘experience’ for a range of design disciplines. Such models are used to define the problem and to help prompt ethnographic user research. An experience
Chapter 1: Introduction to the Thesis

map which illustrates the pragmatic dimensions and emotional responses specific to the play in PBMGs was created to guide the design research process and to ensure that all aspects of the game were considered. This builds on previous attempts by a range of investigators to illustrate the nature of experience for the purposes of prompting user research for a range of interface designs. It will be useful to those investigating the dimensions of any contextually aware app or game and the resulting emotional response from the user.

1.7.5.2 Methods for designing with children

A further contribution to knowledge is the development of a series of participatory methods, placing the child at the centre of a process, focussing on their key emotional needs. Many methods exist to study the younger age bracket (Druin, 1999), however, there are fewer that address clear self-expression for older children. New methods using characters and stories (CAS) have been created that match their level of cognitive development and provide a clear picture of their emotional landscape and latent needs.
Chapter 2: Literature Review

2.1 Overview

2.1.1 Introduction

The aim of this literature review was to consider previous studies that support the design of an optimal experience for situated Location Based MGs (PBMGs) and to gather background information about the real-world problem for this study. We identify three primary areas of investigation:

- Location-based mobile games (LBMGs): examining their properties, history and game design principles;
- Children and nature, and the context of play: investigating the challenging context of play to provide a useful case study for the work;
- Theoretical frameworks: analysing relevant theories and principles that can support the creation of an ideal experience for games.

The three areas of investigation contribute respectively to realising:

- a deeper understanding of the nature of the artefact to be designed,
- a potential context for its use and
- theoretical ideas that support the preferred outcomes of the design process.

This triad of research areas is illustrated in Figure 14. Knowledge generated by combining these studies, where they intersect in the diagram, will provide evidence for subsequent investigations.

![Figure 2-1: Subject areas for the literature review](image)
2.2 Location Based Mobile Games & Game Design

The first part of this literature review focusses on the artefact to be designed, a location-based game.

2.2.1. Introduction

Initially it helps to conceptualize location based mobile games and their properties, with an explanation of how a particularly relevant genre came to be chosen and redefined as a “place based mobile game” (PBMG).

The primary sections are:

2.2.2 A brief history of LBMGs

How LBMGs emerged, and a discussion of omissions in studies so far.

2.2.3 The characteristics of location-based games

Terminology; game patterns that define the genre; global positioning system (GPS) and its influence on game experience; serious versus ludic games and game dimensions such as spatiality, location, time and social factors.

2.2.4 Game design

Areas of game design properties that contribute to game success.

2.2.5 Emotional needs and game success

How game success relates to meeting key emotional needs.

The relationship of this part of the literature review to the whole study is shown in Figure 2-2, with LBMGs and principles shown in red.

Figure Error! No text of specified style in document. 2: Illustration of the literature review focus on LBMGs and game design.
2.2.2. A Brief history of LBMGs

Games that combine both virtual and physical worlds through a mobile device are still a relatively recent phenomenon, at the time of writing. The first commercially available game described as ‘location-based’ is widely considered to be ‘Bot Fighters’ and was created in 2000 (Sotamaa, 2002). Here players were characterised as robots designed to seek and destroy each other in their respective real-world positions, replicating ‘fighting style’ video games. Moreover, around this time, Blast Theory was founded at the University of Nottingham, and they created ‘Can you See Me Now?’ (Benford, 2006). On-line players competed against real human members of Blast Theory on the streets, based on the classic game of ‘catch’.

In 2003, following the introduction of GPS on mobile phones, ‘Mogi’ was launched in Japan by Newt Games, representing one of the first commercial location-based mobile games (Joffe, 2005). Other LBMGs also included developments of traditional games, CatchBob! was an experimental platform in the form of a mobile game for running psychological experiments based on treasure hunts (CHILI, 2007). Researchers have suggested that, in some cases, insufficient emphasis was placed on the spatial attributes that differentiate LBMGs from other traditional games, and their properties were not fully exploited (Benford, 2003; Stanton Fraser, 2005; de Souza e Silva, 2008; de Lange, 2009; Gordon, 2012).

In 2009, Svahn claimed that “despite their potential, very few LBMGs result in commercial success...with the games inability to engage players” (Svahn, 2009).

In 2013, LBMGs began a new phase of popularity among the public with the success of Ingress, developed by Google (Ingress, 2014), screen shots shown in Figure 2-3.
Chapter 2: Literature Review

The backstory is one of aliens influencing Earth via ‘portals’ superimposed onto real landmarks. Ingress had more than one million active players in 4,000 communities worldwide in 2016 (Goel, 2016a). A separate company was formed on the back of this success, called Niantic, funded by Nintendo, Google and the Pokemon company. In July 2016, they released ‘Pokemon Go!’ in the UK; by 12 August 2016, YouGov found that 6.1 million adults in the UK (13% of the population) had downloaded and installed the game, and 5.3 million people were still using the app a month later (Harmston, 2016). Shigeru Miyamoto, a senior director of Nintendo, relates the game’s success to the capacity to design a series of specific emotional experiences (de Winter, 2015).

Despite commercial success, Pokemon Go! seems to have undergone certain safety problems, related to the player’s lack of awareness of their surroundings. Players have been so absorbed that they have encountered hazards in real-world environments, including bodies of water and train tracks, according to an article in the UK Daily Telegraph (Molloy, 2016). On a trip through Preston Station in August 2016, I noticed the screen announcement in Figure 2-4: “Enjoying Pokemon Go? Please consider the following […] Concentrate - it’s easy to get distracted by your phone, music or by catching Pokemon. It is illegal […] to trespass on the railway”.

![Figure 2-4: Screen shots of Ingress, a popular LBMG](image)
Chapter 2: Literature Review

It appears that although LBMGs have demonstrated an ability to engage players, an awareness of the surrounding environment was not a significant part of the experience. To test this out, Ingress and Pokemon Go! were two of the games that I played to gain direct experience, described in the appendix section 8.1. The games required considerable screen-based focus to find the locations required.

Some LBMGs have allowed a more direct relationship between the virtual and physical worlds. Geo-caching is a recognised phenomenon in certain communities, and it relies on an awareness of the surroundings to find a location and navigate the terrain. It started out as a non-digital activity where participants would hide and seek real physical containers or caches. The originator would leave what they perceived to be ‘treasure’ or information for others to find: the finder observes and possibly changes the content of the cache and records their visit. This process was digitised, and several geocaching apps were created using GPS to make the finding and hiding more enticing; the treasure could also be virtual, rather than real. Groundspeak is one of the main providers (GroundSpeak, 2000).

In an attempt to understand this experience first-hand, I used the Geocaching app to retrieve a series of caches in the local area: though it was an interesting experience, there was no real enticement to continue with the activity as each
event is singular. Notes about the experience are provided in Appendix Part 1. Despite nearly 3 million people having registered to do geo-caching, it is estimated that only around 300,000 people are active regular seekers of the caches. The player is required to navigate, using maps and descriptions, thus being aware of the surrounding terrain, but information embedded within the environment is not necessarily significant to the game goals.

Unlike Ingress and Pokemon Go!, the geocaching activity does not usually depend on a narrative or fantasy world to engage the player. Feulner, (2016a) reviewed the potential for studying geography through GeoGames with a strong emphasis on understanding information within a landscape. However, despite increased experiential learning being recorded, she was sceptical about the extent to which location-based educational games have engaged players (Feulner, 2016a). Car-Chellman (2010) had already noted concerns about the engaging properties of games that had an educational component, concluding that “the entertaining properties afforded by commercially available games should be leveraged to increase motivation for a range of purposes”. Game designers have noted that the addition of a narrative, in particular, can add entertainment value as it reframes the ordinary through play (Sotomaa, 2002; de Souza e Silva, 2008).

Experts describe the situation for designing engaging LBMGs as complex because the boundaries of the game space can be uncertain compared with screen-based games; in physical spaces, the edges of the game are not exact (Benford, 2003; Benford, 2004b; Bell et al., 2006). It has also been noted that navigating the game space can require more physical and cognitive effort, which needs to be overcome to maintain engagement (Ritchie, 2014). Ejsing-Duun (2011b) suggests that due to the relative novelty of this field, the design requirements for LBMGs, where a connection to place is desired and an engaging experience is maintained, require further exploration from both a practical and affective perspective.

A considerable proportion of research projects and developed LBMGs have been
situated within urban environments. Books, such as ‘Digital Cityscapes’ (de Souza e Silva, 2009), describe research and development in cities or around civic landmarks. In Avouris and Yiannoutsou’s (2012) study of hybrid games with both educational and ludic properties, only one out of the 15 studied, Savannah, based on role play of the behaviour of lions (Benford, 2004a) was based in a more natural environment. However, the game content did not depend on particular features in the landscape.

A series of researchers have investigated mobile learning in natural environments, including Wilde (2003), Rogers (2010), Brown (2010) and Eliasson (2013). However, these examples were related to natural science and curriculum-based activity and follow the principle of ‘taking the classroom outside’. Other research to support non-urban games includes the work of Jordan et. al. (2013) to investigate how structural landmarks are identified in a park by tracking the movements of players. Further non-urban games will be referred to throughout this literature review however those found were not focussed on the player experience.

2.2.2.1. Discussion and implications for research

The commercial success of LBMGs, such as Pokemon Go!, suggests that they can be popular with children and the public, so there is something to be learned about creating desirable games from their developers (Goel, 2016b; Harmston, 2016). Success in these cases has been linked to addressing key emotional needs (de Winter, 2015). Nevertheless, awareness of surroundings has not been an attribute of commercially successful games so far, including Ingress or Pokemon Go! (Molloy, 2016). Researchers have concluded that the engaging properties of games where players learn about an environment can be improved (Car-Chellman, 2010; Feulner, 2016a). Difficulties with maintaining engagement have been associated with: a lack of understanding of how to effectively include the landscape; the increased physical and cognitive effort to navigate during play and the need to better address the key emotional needs of the player. Adding narratives, addressing emotional needs and increasing the entertainment value can also entice the player to engage (Sotomaa, 2002; de Souza e Silva, 2008). This preliminary review of literature, therefore, suggests that LBMGs have the
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potential to create an increased connection and learning within an environment however a series of difficulties need to be addressed, particularly addressing levels of effort and emotional needs to overcome them.

According to Avouris and Yiannoutsou (2012), the majority of games researched are situated within urban environments, which may be because they are easier to access and navigate, with more structured arrangement of streets and features, compared with rural areas. Where games research was situated in non-urban environments, there has little focus on the properties that make a game with awareness of surroundings enjoyable. In general, understanding requirements across different applications and contexts is part of the maturation of any research field, and is, therefore, an emergent need in this relatively new area (Ejsing-Duun, 2011a). This progression is represented in this study by a focus on the engaging qualities of LBMG’s when playing in natural spaces for children.

2.2.2.2. Key points

- LBMG’s have the potential to connect players to places in the real world and to increase awareness of their features.
- Games that have so far been successful commercially have not attempted to create a connection between players and information embedded in the physical world.
- Qualities that engage the player found in commercial games, such as addressing emotional needs, may help to overcome the complexity and effort involved with LGMGs.
- LBMG’s engaging qualities still need to be fully evaluated for certain contexts: this thesis extends this knowledge to natural environments.

2.2.3. The characteristics of location-based games

2.2.3.1. Definitions

De Souza e Silva (2009) considers that there is little consensus about terms or definitions for games that stretch across virtual and physical worlds. Common terms are pervasive games, mixed reality games, augmented reality games and
location-based games. So how is an LBG distinct from other genres, and why are they preferable for this research? Certain researchers describe an LBG as an instance of a pervasive game where the gameplay is dependent on a user’s location. Pervasive games are defined as extending the gaming experience into the real world (Walz, 2007). As Montola (2009) argues, “pervasive games extend spatially, temporally or socially the boundaries of typical games and can often be played anyplace any time”.

Early examples of pervasive games are also frequently called LBGs. Examples include ‘Can You See Me Now’, and the later version ‘Uncle Roy’ (Benford, 2006). The term pervasive later became associated with a level of permanency and multiplayer games; when an individual player stops playing the game, the game world continues without them. This term does not, however, encompass every LBG as some are based on activities, events or performances that take place within a particular timeframe by an individual. Certain educational LBGs that have been explored replace classroom sessions with the teacher and are specific events (Eliasson, 2013). This points to the necessity of exploring issues of permanency and duration. The ‘Can You See Me Now’ experience was also described by Benford, (2004b) as a ‘mixed reality game.’ This term has been used where players navigate a fantasy world, superimposed over the real world (de Souza e Silva, 2009). However, some LBGs use a real-world Google map for finding their way, and the real world is the playing field, so this is not necessarily a shared feature.

It has been noted that “LBGs are not limited to a screen, nor are they limited to the physical world. They promote a ‘doubled perception’ of space, enabling simultaneous access to both physical and digital spaces” (Gordon, 2012). The virtual space may contain characters or scenes that appear to be superimposed on the real world, as well as puzzles or activities based on the surrounding physical objects (Gordon, 2012) illustrated in Figure 2-5.
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According to Lehman (2012b), Location Based Games can be identified by their dependency on Location Based Services. The connection between worlds, however, can be made via a variety of means, including GPS, internet, near-field technology or bar codes.

2.2.3.2. Discussion and implications for research

An LBG has been shown to share common properties with pervasive or mixed reality games and there has been some duplication of terminology and features across genres. However, the common connection and therefore defining characteristic of an LBG is their dependency on location, most commonly through location-based services (LBSs). LBG’s are capable of creating an enhanced view of the physical world and providing those who are situated in a particular place with a wealth of associated activities in an engaging way and are, therefore, an appropriate choice for this project.

A further contribution of this thesis will be to consider the exact form of LBG’s appropriate for connecting people and places, this emerges through this chapter with an analysis of their properties and purpose, with the suggestion of a new term “Place Based Mobile Games”.

Though there are a variety of ways to connect real and virtual space, interviews with stakeholders for this project revealed that adding physical objects to a natural space was not appropriate (described in more detail during phase 1 of the design research, Chapter 3). It also became clear that there are possible legal and ethical considerations of adding foreign bodies, since often parks and woodlands are public spaces. At the time of writing, object recognition is not reliable enough
to implement, though later experiments are included during design research to confirm this point. GPS and Location Based Services are therefore a non-invasive alternative and most widely accessible solution, described in more detail to follow.

2.2.3.3. GPS and mobile technology

GPS (Global Positioning Satellite) is the most practical and widely available technology for location-based activity (Lehman, 2012). Wherever we are on the planet, at least four GPS satellites are visible at any time. Each one transmits information about its position and the current time at regular intervals. These signals, travelling at the speed of light, are intercepted by a GPS receiver, which calculates how far each satellite is, based on how long it took for the messages to arrive. Once it has information on the distance of at least three satellites, a user’s GPS receiver can pinpoint their location using a process called trilateration (IOP, 2014). GPS modules embedded in commonly used user devices and smartphones may also use assisted GPS to gain the approximate location from the phone signal. The mobile signal is then used to speed up the calculation of the position fix. Locating a device could involve Wi-Fi, cell tower triangulation, single cell tower or IP (Lehman, 2012). In practice, mobile devices may combine a range of these technologies to rapidly assess position, generically described as LBSs. Wi-Fi or other alternatives can be absent in natural environments, however, and locating a device can be slower. Games played on mobile devices with GPS capability are called Location Based Mobile Games (LBMG’s). Jacob and Coelho (2011) point to potential problems with GPS in that games become unplayable in areas where signal is unavailable.

Figure 2-7: GPS and LBMGs
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2.2.3.4. Emerging areas for investigation

- How can GPS reliability and other technical constraints impact on the experience of play for the natural environments under study?

2.2.3.5. The motivation provided by games and their purpose

Games are used for a range of purposes from pure entertainment to more serious applications. McGonigal (2011) suggests that the motivational properties of games are so effective that we should leverage their power to reinvent everything from government to health care and education. The escapism available, sense of purpose they afford and control over our environment are extremely enticing to many people (Rigby, 2011). The positive feedback that games provide about our actions within a fantasy world can make us feel like we have an impact. McGonigal (2010) also claims that we do not receive the same feedback in the real world, which is why games can be seriously addictive. Games have, therefore, been created for a range of serious, and often educational, purposes for children. Games for play are described as ludic. Ejsing-Duun (2011b) refers to the spectrum of intent between the ludic and serious as “play and ordinary”. Because all games can both ludic and serious properties, classification must be based on the intent behind the game, defined from the perspective of both the developer and the user (Frasca, 2003). Educational games are a subset of serious games. These LBGs have been further categorised by Avouris (2012) as:

1. ludic (games created for fun).
2. pedagogic (games created for learning).
3. hybrid (games that are pedagogic and ludic).

2.2.3.6. Discussion & implications for research

The categorisations provided by Avouris (2012) suggest that games for this context should fall in to the hybrid category. The game is classified by its intent, which in this case is to allow young people to enjoy being in a natural environment, but also to raise their awareness and enable experiential learning. How the game properties help achieve their purpose is considered in the following sections.
2.2.3.7. Relationship to place, time and other beings

Ejsing-Duun (2011a) considers the pragmatic dimensions of LBMGs and includes:

- Location, spatiality and game space.
- Time, duration and the nature of game events.
- Social interaction.

Lehman (2012) describes the relations between the elements listed above through the notion of game patterns in the following way:

**Chase and catch:** find a moving object or another player in the game world against time. This can be a single player if hunting an object, such as a fox hunt (Misund, 2009). The qualities of the real world are irrelevant.

**Change of distance:** this pattern involves the player moving nearer to or further away from a point: it is the movement that matters, rather than the final destination or the direction.

**Search and find:** here a player has to find a distinct geo-location or a particular object, such as a historical building or other landmark. Geocaching is one of the earliest examples. There may be only one point of interest, or many destinations. This might involve a ‘treasure hunt’ style activity or an interactive narrative.

**Follow the path:** this is similar to search and find, but the location must be found by following a particular route. Players are rewarded for following the path or penalised for straying from it. Locomatrix created ‘Invisible Buildings’, where players have to reveal the outline of an archaeological dig with this pattern (Winter and Pemberton, 2011).

The success of a treasure hunt approach for experiential location-based learning has been demonstrated through an EPSRC funded research project named My Mobile Mission (Smith et al., 2008) to find locations with sustainable energy on Sussex University campus. It built on the work of Scanlon, Jones and Waycott who noted that “children were able to effectively integrate mobile devices into their activities and were strongly motivated to do so with the engaging treasure hunt context” (Scanlon et al., 2005).
2.2.3.8. Discussion & implications for research

A race against other people or objects has been shown to be counterproductive to engaging with an environment, and it is also potentially dangerous in physically demanding terrain. Therefore, the ‘chase and catch’ game pattern can be discarded. The ‘change of distance’ pattern is not dependent on specific locations and might also suggest a race. Of the remaining two patterns, the search and find model is most appropriate for a game in which locations are significant. ‘Finding the path’ patterns, have an exact dependence on GPS that could create problems where there is weak signal, more likely in rural environments. During preliminary research, I investigated this for myself, through playing the ‘Invisible Buildings’ game by Locomatrix. Though an interesting experience, it required a lot of head down interaction to ensure the path was followed, which is contrary to the aim of this project, to engage with the physical world. They are also less flexible as a game structure, compared with a search and find, which allows treasure hunt activities, leading to a more exploratory and diverse experience. The ‘search and find’ or ‘treasure hunt’ approach is the therefore the most appropriate for this project.

2.2.3.9. Proposed design guidelines: game patterns

- To provide experience of specific elements of a landscape, the ‘search and find’ or ‘follow the path’ patterns should be followed.

2.2.3.10. Emerging areas for investigation

- How do the pragmatic dimensions of location, time and social interaction, influence the experience of the game?

2.2.3.11. Relationships with location and spatiality

The relationship of the player’s position to the progress of the game can vary. In certain cases, the relative location of phenomena is the predominant concern, while others critically depend on exact locations. According to Avouris, (2012), the location of a player can be:

- Relative to game features: the early LBG, ‘Botfighters’ was dependent on the relative location of other players (Sotamaa, 2002).
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- **Situated** in a chosen environment (but without specific GPS locations): Pac-Manhattan was a large-scale urban game illustrative of a situated game that recreated the 1980s video game Pac-Man (Manhattan, 2009).
- **Absolutely positioned** (based on exact GPS coordinates): the relationship between player position and gameplay is based on the exact GPS location. Geocaching is a well-known example of a digital scavenger hunt requiring an exact GPS to investigate the specific site in an LBMG. Ingress and Pokemon Go! are also in this category.

Ejsing-Duun asks “is there a direct correlation with the locative content and the game play?” (Ejsing-Duun, 2011b). For some absolutely positioned LBMGs, the gameplay will depend on what is found at a location, and for others, it has no relevance. The most popular and widely played LBGs, Ingress and Pokemon Go!, require the player to find specific GPS locations; however, the information embedded in the real environment is irrelevant beyond using recognisable landmarks for navigation (Goel, 2016a). Images of features are included to help find locations, but whether they find a museum, statue or Buckingham Palace at the end of each journey is irrelevant to achieving the aims of the game. In instances where the real-world setting is a critical part of gameplay, it often falls into the category of being site specific. Relevant information can be positioned at a significant place and only released to those who visit and interact with the surroundings (Oppegaard, 2014). RExplorer provides an example game, dependent on its situation, which also helps to raise an awareness of the space visited. This was launched in Regensburg, Germany to promote tourism and engage players with local historical sites; players can take photographs to record the surroundings and add them to their weblog to reinforce their memories. Although the game has a backstory, the information embedded in the environment is critical to the gameplay, and it is a site-specific, situated game (Walz, 2007). Specific objects may also be part of a site-specific experience, such as MyArtSpace (Vavoula et al., 2009), where children can collect virtual items in a gallery by visiting real ones in certain and exact positions.

In a survey-based study, Avouris and Yiannoutsou (2012) found that 67% of
hybrid games were designed to be played in specific places, with the rest extended to any place in which other players can be found. De Souza e Silva and Sutko (2008) observed that location-based activities can produce learning that is social, experiential and situated; therefore, mobile learning projects often provide examples. To illustrate the difference, the Ambient Wood project (Rogers et al., 2004) provides an example within a natural environment that integrates information from the surroundings to a large extent; it is site-specific, but it is not absolutely positioned through GPS. For example, you can observe photosynthesis using any available tree, but the play needs to be inside a wood.

2.2.3.12. Discussion and implications for research

According to Lehman (2012), to direct players to particular areas of interest in the natural world, an absolutely positioned game will be necessary. The degree to which information embedded within the physical environment is integrated into gameplay ranges from being unrelated to being integral to the purpose (Ejsing-Duun, 2011a). When real world environments and objects within games are significant, the LBMG is often site-specific to that place (Vavoula et al., 2009; Rogers, 2010). LBMGs have the potential to direct players to specific points of interest in a natural environment, with phenomena integrated into the gameplay. Picking out features can help to raise awareness of a place, demonstrated by RExplorer (Walz, 2007). Although the real location can be critical to play, this does not preclude the use of a backstory integrated in different forms, demonstrated by the RExplorer game (Walz, 2007).

It is proposed that for games that are both absolutely positioned and situated, in order to create connection with place, a term ‘Place Based Mobile Game (PBMG)’ should be used to simplify the discussion.
2.2.3.13. Key Points

- To direct players to specific features in a landscape, the game needs to be *absolutely positioned* to particular GPS points.
- To direct players to learn about specific locations in the real world, the game should be *site specific*.
- To simplify terminology, games that have both the above attributes will be described as ‘Place Based Mobile Games’ (PBMG’s).

2.2.3.14. Complexity across real and virtual spaces

Ritchie, (2014) describes the presence of simultaneous events that require attention in the context of using virtual media across physical spaces. Successive experiences evolve over time and space in the digital world; by contrast, the physical environment requires that the audience receives information from a variety of stimuli, similar to watching a play or performance. Frohberg (2009) studied 38 mobile learning projects: for 28 of them, the mobile technology was reported as too dominating. The specific digital aspects that were seen to add distractions were animations, moving images and excessively confusing features. The conclusion was that elements such as these should only be added where they add value and are significant to the purpose of the presentation at a given point in time.

Cole and Stanton (2007) compared their projects, KidStory, Hunting the Snark and Ambient Wood, and reported that the students had difficulty shifting their attention away from the technology. Eliasson, (2011) also noticed mobile devices distracting students from interacting with the natural environment and described similar findings on tests for an AR interface called MapLens. Schwabe and Goth (2005) created MobileGame, and their research proposes a series of guidelines to counteract the problem of too much screen-based focus: 1. Plan in the focus switches to the activity (when the participant might look at the screen and when they might look at the environment); 2. Use the technology only when it adds value; 3. Do not use animations if the application is meant to be in the background; 4. Reduce features as much as possible. In the Caerus project, by Naismith et al. (2005), users were moving around a botanical garden. However,
as the users were focused on the guide to help navigate the space, there was a problematic “large amount of ‘head down’ interaction” due to the mental effort required to use the application.

2.2.3.15. Discussion and implications for design research

For a range of previous research projects too much focus on the screen was noted, rather than the surrounding landscape (Schwabe & Goth, 2005; Frohberg, 2009; Eliasson, 2011). The problems were related to switching attention between the virtual and real spaces (Ritchie, 2014), and overburdening the player’s cognitive resources with wayfinding and distracting screen media (Naismith, 2007). Ensuring that the player attends to the real environment at appropriate times will be important for this project. Modified versions of the guidelines offered by Schwabe and Goth are suggested for this project below.

2.2.3.16. Proposed design guidelines

- Plan in focus switches in the game between the real and virtual world.
- Use technology only when it adds value.
- Do not use distracting media.
- Reduce unnecessary features where possible.

2.2.3.17. Emerging areas for investigation

- How can attention be directed towards the real environment at appropriate times, so that the player feels connected with the physical world and learns from it?

2.2.3.18. Relationship to time

The concept of time for LBMGs can be discussed from a few different perspectives, for example: whether the game is always available or occurs at a given date and time, whether the game is singular or a repeatable experience and the duration over which the player is required to reach an overall game goal or to complete an intermediate task. Certain commercial games exist in situ for as long as they are 'published' to the public: absolutely positioned examples are Geocaching, Ingress and Pokemon Go!, which are considered ‘pervasive’. Absolutely positioned examples are Geocaching, Ingress and Pokemon Go!,
which are considered pervasive, because players can dip in and out of the gameplay as required. Other games are more of a performance and are screened or demonstrated on a specific set of dates or times, in the same way as a theatre showing. ‘Riot!', for example, was an interactive play showing the original riots of 1831, over three weeks in 2004, in Queens Square Bristol. The original experience involved audio immersion into a dramatic historical event; later an AR piece with a similar theme was also installed at Nottingham Castle (Patel & Tuck, 2013).

A further relationship to time is the potential to include different timelines: situated content from the past or even the future can be presented in virtual form, superimposed on the present day. In a report from the STELLAR workshop group, Cook (2010) describes a project at an abbey in Yorkshire, illustrating a possible reconstruction of the original old (now demolished) church interior through AR. For RExplorer, ghosts of historical characters from different eras were presented in historical places (Walz, 2007).

LBMGs may offer a ‘once only’ experience for each player although it is permanently available for others, a virtual tour where different locations are indicated, but is only of interest the first time, are an example. Alternatively, a game may be experienced many times. Geocaching enthusiasts, for example, will play the game on different occasions even though each may involve only one visit to a GPS point. The number of points visited during one gaming session will depend on the distance, the time available and the player’s appetite for more. Distances travelled to play the game will also logically affect the timing and duration of play. Other games are intended to include more points as part of the experience. For instance, this could be a tour or mobile story.

In terms of duration, the time playing at any one instance might vary from minutes to hours. Avouris and Yiannoutsou (2012) surveyed 15 games through Google Scholar and found that the duration of educational LBGs can vary extensively: 58% lasted less than a day, and a typical duration varied from 30 minutes to half a day.
2.2.3.19. Discussion & implications for research
Games with commercial success fall into the category of being ‘always available’, which is unsurprising as they are likely to be the most convenient and therefore popular with the player (Das Gupta, 2016). They are also usually repeatable in different locations. For this real-world problem, therefore, a pervasive, repeatable game would be preferable as this can be accessed at a time suitable for the player and allows game longevity and repeated visits to natural sites. The point about different timelines is also interesting, allowing media to be played that represent a natural location at different times, when different events, flora or fauna may be present.

2.2.3.20. Proposed design guidelines

- For a game to achieve popularity it helps if it is pervasive, so that it is always available to the player
- The ability to play the game multiple times can contribute to success and encourage multiple site visits, an aim of this research.
- Media can be presented that show a location at different points in time to add further interest.

2.2.3.21. Emerging areas for investigation: time and sequencing

- What kind of duration should the game and activities be for, this context, to meet the abilities of the audience and the demands of the terrain?
- How does the sequence of activities and number of events affect the experience?

2.2.3.22. Social connections

There are potentially various ways that players can interact with each other through LBMGs, from incidental encounters, shared activity, competition or later web-based interactions. Nevertheless, there have been safety implications associated with face-to-face, incidental or planned encounters with unknown players: “almost everyone who’s played Pokémon Go has a story about encountering someone out in the real world who’s also on the hunt” (Staff, 2016). Safety problems are generally because players can be located. Security problems are also illustrated by a Guardian article entitled “How I became a
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Foursquare Cyberstalker” about a location-based service, known as Foursquare (Hickman, 2010). In this piece, the writer describes how they learned the exact locational habits of a total stranger and were able to find photographs of them due to GPS tagging of images at locations.

Due to these potential dangers, a possible alternative is finding indirect ways to connect with others. The LBMG Mogi is a collecting game based in Japan: the player can pick up virtual items placed all over the country and social interaction is possible through virtual trading with other players (Joffe, 2005). If typical activities are included without locational information, this is a potentially safer method. The social context also affects the relationship to space (Benford et al. 2003); collecting treasure in a quiet park will be a different experience to being in a busy area. Other projects, such as the Ambient Wood, involved groups of children playing together (Randall, 2004) since playing alone is also not ideal for children.

2.2.3.23. Discussion and implications for research

Evidence suggests that indicating the position of other players within the game can have safety implications. Other indirect methods, such as rewards or competition, outside the game might be an alternative. Playing in groups is also desirable.

2.2.3.24. Proposed design guidelines

- Adding a social dimension to a game can make it more popular, however, it can also have safety implications.

2.2.3.25. Emerging areas for investigation: social dimensions

- How can a social dimension be represented or added to a game safely?
2.2.4. Game design

2.2.4.1. The elements of game design

The elements of game design success can be seen to differ according to different researchers. For educational games, Malone considered that there were three main aspects that motivate: challenge (in relation to goals), fantasy and curiosity (Malone, 1982). For Pearce, the following elements are critical for all games: a meaningful goal, resources, rewards, penalties and appropriate information, all of which can contribute to motivation and engagement during a play experience (Pearce, 2011). Fullerton (2008) suggests that, to support player engagement, challenge, play, premise, character, story and dramatic elements are crucial elements. In order to better understand how a game can relate to these different attributes, it helps to break them down first into tangible game elements, described simply by Rollings: the core mechanics that create the gameplay, the narrative (and content if factually based) and the interaction between these elements. The elements are described in more detail below (Rollings, 2003).

**Core mechanics:** the foundation of the gameplay depends on the core mechanics, the basic game mechanisms, procedures and rules that define the way the game world operates. (Rollings, 2003). Core mechanics must be created at an appropriate cognitive level for the audience: if the intended audience cannot understand what is expected of them or operate within the rule framework, the game will fail.

**Content- narrative, premise or story:** the French philosopher Paul Ricoeur argued that we draw together disparate events into a meaningful whole by establishing causal and meaningful connections between them through our own narrative (Ricoeur, 1991). This tendency can also be extended to other representations of life, such as within a game, as it is considered to be a valuable tool to organise an experience (Aarseth, 2004). Narrative can therefore help combine different elements including characters, information, actions and events into a more meaningful whole or ‘Gestalt.

Rigby and Ryan provide the example that “killing demons is fun, but killing
demons with your mind to save the woman you love is more fun” to illustrate how a backstory can add a greater sense of purpose and volition to a game activity (Rigby, 2011). These authors also suggest, nonetheless, that unlike traditional media, the content (including story, characters and objects) is not the only factor for games, but the Player Experience of Needs Satisfaction (PENS) model, which also manifests through both the interactivity and gameplay, is the most significant for success.

Two types of narrative were previously identified by Juul that also illustrate this point (Juul, 1998):

**Embedded narrative:** a pre-generated content that exists prior to a player’s interaction with the game; a fictional background for the game; motivation for actions in the game, and development of the story arc.

**Emergent narrative:** A more abstract form of a narrative that arises from the player’s interaction with the game-world; moment-by-moment play creates it; and it can vary each play session.

The first type is commonly associated with ‘story-based games or adventure games, the second to game design that depends on rules and relates more directly to a ludic approach.

Avouris and Yiannoutsou (2012) suggest that typical genres such as adventure or role-playing games that depend on a story seem to have a higher learning potential than others. Considering the most cited games, four (27%) have a stronger narrative component, and three out of these four games (Savannah, Frequency 1550 and Riot!) have a pedagogic nature. However, some educational games have been criticised in this respect. At a TED conference, it was suggested that “they [educational games] are glorified drill-and-practice. They don’t have the depth and rich narrative that really engaging video games have” (Car-Chellman, 2010).

A story is a form of structured narrative, usually with a beginning, middle and end (Jennings, 2016). Design guidelines have been created by Ardito (2010) for generic LBGs including narrative and how this relates to story; consider: integrating the backstory as the basis of game tasks; role-playing to meaningfully
link tasks to the backstory. Location-aware stories are a particular kind of location media that aim at “telling stories that unfold in real space” (Karapanos, 2012). According to Ritchie (2014), the sequencing of events can alter the meaning of a located narrative. He discusses the Kuleshov effect: the order in which we see or experience narrative elements influences the perception of later elements (Kuleshov, 1919). For instance, if players were primarily directed through a slaughter house and afterwards into a peaceful cow pasture, their interpretation of the peaceful field would be different to those who were guided directly into the field. Therefore, movement can create narrative, however a narrative can also help to direct players, discussed further in the section on wayfinding.

2.2.4.2. Discussion and implications for design research

Using narrative appropriately for hybrid games can be an effective way to connect disparate elements of a game into a coherent experience, connecting intermediate tasks meaningfully with the overall game goals (Ricoeur, 1991). This can benefit both their entertaining and educational properties (Car-Chellman et al., 2010; Rigby, 2011; Avouris & Yiannoutsou, 2012). A narrative could potentially aid in navigating the space or linking locations, how this should be implemented, through story based or ludic approaches, will be considered during this design research, along with the influence of different sequencing. However, Rigby and Ryan (2011) also argue that the players’ experience of needs satisfaction is the most important factor in player engagement, and needs can be met through the core mechanics, or interaction besides the narrative, a structural representation of games also described by Rollings (2003). Therefore, meeting key emotional needs and how they can be met will also be further investigated. Because LBMGs also exist in the real physical world, the relationship between the narrative, fantasy and reality will be considered in the next section.
2.2.4.3. Proposed design guidelines:

- The core game mechanics and narrative elements should relate to the emotional needs of the player and should be appropriate for the intended audience.
- A narrative or premise should be included to set the scene for the game action and to establish the overarching game goals: this may be in the form of a linear story or a more flexible narrative.

2.2.4.4. Fantasy and reality in LBMGs

According to Ejsing-Duun, LBGs reside on the boundary between “authentic and fictional” as they merge physical and digital media. She asks the question “is the game based in reality or a fantasy world?” (Ejsing-Duun, 2011a). Placing our interpretation of reality and the physical world into a fantasy fictional setting is potentially entertaining because it allows us to reframe the ordinary through play (Sotomaa, 2002; Frasca, 2003; de Souza e Silva, 2008; Ejsing-Duun, 2011b).

The game play can also vary in its relationship to reality. When it is manifested through roleplay, casting the player as part of the game, it creates a fantasy element that has been associated with game success, for example, discussing Pokemon Go, Das Gupta stated that: “with this game […] I feel as if I AM Ash [the lead character] in real life. The execution of that fantasy is paramount” (Das Gupta, 2016).

Piaget explains fantasy in children’s play primarily as an attempt to assimilate experience into existing structures into their mind, with minimal need to accommodate the demands of reality (Piaget, 1962). Freud also suggests that fantasy can help to retrospectively gain emotional mastery over previous experiences (Freud, 1950). Malone suggests that though these theories consider fantasies that children produce, they would also dictate the fantasies people find appealing (Malone, 1982).

2.2.4.5. Wayfinding and Fantasy Worlds

The presentation of media for ‘wayfinding’, particularly game maps, can also vary in their relationship to reality. The Oxford Dictionary defines wayfinding as “the
process or activity of ascertaining one's position and planning and following a route”. Tools to achieve this include maps, spatial recognition, contextual clues and sensory guides (Fillion, 2010). However, the addition of an imaginary world, represented on the game map, can be a distraction from reality. For example, an early LBG called ‘Perplex City’ was created by Mind Candy, a game that merged London into a fantasy setting where players competed against one another to find clues to a mystery artefact (Das Gupta, 2016). Although the player found specific locations, London was regarded as ‘somewhere else’ in the player’s imagination, and the real streets and monuments were not seen as significant to the game content.

Pokemon Go!, a ‘mixed reality’ game, also uses an imaginary map superimposed onto the real world, shown in Figure 2-8. It has been claimed that “exploration of a new world is one of the game's key core mechanics” (Das Gupta, 2016). However, I noted that when playing Pokemon Go!, (an account of games played is in the appendix section 8.1) there was extra difficulty when translating the fictitious map into reality. This was mitigated slightly by the use of photographs of buildings or monuments in their real setting to provide landmarks at specific GPS points helps the player recognise when they have arrived.

Figure Error! No text of specified style in document.-8: Example of a Fantasy World Map with real images of locations, Pokemon Go!

2.2.4.6. Discussion and implications for research

Fantasy elements, created through role play are potentially motivating and can
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relate to an adventure game, found to be appropriate for educational purposes (Avouris, 2012; Das Gupta, 2016). A fantasy world map is potentially more difficult than a normal Google map to use even in urban environments, based on the experience of playing Pokemon Go! at first-hand. Established landmarks in urban spaces can help wayfinding by discovering key locations: the use of similar images could perhaps help locate and identify points in more rural environments.

2.2.4.7. Emerging areas for investigation

- Should fantasy and role play be pivotal to the game?
- What kind of wayfinding tools are appropriate for the audience, and what is their relationship with reality versus fantasy?
- How should the game be sequenced, linearly or non-linearly?

2.2.4.8. Classifying play

Most games, physical or digital, are based on the experience of play. It can be helpful, when trying to understand the nature of games, to consider how play is defined. Frost (1992) identified the three following ways:

- Functional play: physical play, such as running, jumping, tumbling and climbing.
- Constructive play: building things, such as huts, shelters, often enabled by objects like sticks, cones or pebbles.
- Symbolic play: roleplay, dramatic play and social play, including playing house. Places to hide, forms that resemble objects in real life, clearings or peep holes that promote social interaction enable this kind of play.

However, Hughes (2002) recognizes up to 16 different play types when less physical forms of activity are included:

- Rough and tumble play: typified by play fighting.
- Locomotor play: movement for its own sake, such as hide and seek or tree climbing.
- Mastery play: control of the elements of environments, as in changing the course of streams.
- Object play: novel use of any object, including twigs.
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- Creative play: play that allows self-expression, enabling children to use their imagination.
- Social (rule-based) play: any interactive situation where there are rules or protocols to follow.
- Exploratory play: accessing the properties of an object or area through exploration.
- Imaginative play: conventional rules in the physical world do not apply, such as patting an invisible dog.
- Symbolic play: using an object or situation to represent something else, as in a piece of wood resembling a person.
- Fantasy play: make believe worlds where impossible features, such as having super powers, are possible.
- Dramatic play: the re-enactment of experiences of a personal, or domestic nature.
- Roleplay: exploring ways of being, not necessarily personal or interpersonal, as in being a knight.
- Communication play: conversation, voicing opinion through any media.
- Deep play: encountering or imagining risky experiences, to conquer fear and develop survival skills.

2.2.4.9. Discussion

Hughes' (2002) work describes a large number of play types, some of which have narrow distinctions between them. Table 2-1 simplifies these categories for later discussions on play by using Frost (1992) and Hughes' (2002) work as a reference:

<table>
<thead>
<tr>
<th>Basic play type</th>
<th>Interpretations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional (physical)</td>
<td>Locomotor (climbing), mastery (changing things) and object play.</td>
</tr>
<tr>
<td>Imaginative play</td>
<td>Imagining scenarios, fantasy, symbolic, dramatic or roleplay.</td>
</tr>
<tr>
<td>Constructive play</td>
<td>Building and making things.</td>
</tr>
</tbody>
</table>
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<table>
<thead>
<tr>
<th>Play Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creative play</td>
<td>Self-expression through new forms, art and sculpture.</td>
</tr>
<tr>
<td>Communicative play</td>
<td>Voicing opinions and conversation.</td>
</tr>
<tr>
<td>Rule-based play</td>
<td>Games with rules.</td>
</tr>
<tr>
<td>Social play</td>
<td>Playing with others</td>
</tr>
<tr>
<td>Exploratory play</td>
<td>Accessing information or experiences through exploration.</td>
</tr>
<tr>
<td>Deep play</td>
<td>Risks in real or imagined situations and survival skills.</td>
</tr>
</tbody>
</table>

2.2.4.10. Play Types and LBMG’s

LBMG’s, can be considered in terms of their core game mechanics and how they relate to identified categories of play. Fullerton (2008) suggests that any game design requires rules, therefore all LBMG’s exhibit ‘rule-based play’. Games based on a ‘search and find’ pattern, defined by Lehman (2012) can be considered to include exploratory play, by their nature.

Different forms of imaginative play have been included in previous games. Fantasy-based play where players suspend disbelief to participate in an imagined world is the most common example. The back story behind Ingress, for example, is that aliens are attempting to become part of human society (Ingress). Imaginary play is also seen in the form of role play, demonstrated by Savanah (Benford, 2004a) where the player assumes the identify of one of the lions to learn about behaviour. Participatory simulations, first described by Colella (2000) also represent imaginary play, placing the player within an imagined dynamic system that represents a possible real-life situation. Environmental Detectives, for example, included the simulated spread of a deadly toxin scenario and the player takes the role of a chemical engineer to try and solve the problem (Klopfer & Squire, 2007). This could also represent dramatic play, where a possible real scenario is being acted out. Lonsdale (2004) describes a mobile learning application that includes constructive play in situ, where school children choose sites for flood defences to be built. There is also an element of deep play for both Environmental Detectives and the latter project, where participants deal with risks and survival tactics.
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Some games include social play, such as Pokemon Go!, where players can physically interact with others or compete against them online (Das Gupta, 2016). The CityExplorer project also allowed participants to communicate and record findings, thus including communicative play.

2.2.4.11. Discussion and implications for design research

Search and find game patterns have been identified as the best fit for the aims of this project, therefore, exploratory play is likely to be significant. Though LBMG’s require physical movement around a space, functional play was not cited as being important to the game mechanisms in the literature discovered. Since an aim of this game design is to include physical interaction with an environment, to increase engagement with surroundings and offset health and wellbeing issues, investigations the desirability of including functional play mechanisms will be considered. Creative play was also underrepresented, along with symbolic, object and dramatic play. Social play and communicative play are harder to include safely, due to the risks associated with strangers, discussed in section 2.2.3.22.

The play types encountered in a range of commonly cited games discussed in this literature review section are compared with other game design attributes in Table 2-2. Narrative type (column 3), relates to whether the narrative is embedded (e.g. story based or an adventure game) or whether it is emergent (abstract connection, based on the players interaction). This is compared with game ‘purpose’ in column 4 (Serious, ludic or a hybrid) and also the relationship between the game narrative and the player’s surroundings (column 5). The final column shows the intended situation of play.

<table>
<thead>
<tr>
<th>Game Title</th>
<th>Play Types</th>
<th>Narrative</th>
<th>Purpose: Goals &amp; Place?</th>
<th>Urban/Rural/Either</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geocaching</td>
<td>Exploratory</td>
<td>Emergent</td>
<td>Hybrid</td>
<td>Y</td>
</tr>
<tr>
<td>(Groundspeak, 2000)</td>
<td></td>
<td></td>
<td></td>
<td>Either</td>
</tr>
<tr>
<td>CatchBob!</td>
<td>Exploratory</td>
<td>Embedded</td>
<td>Ludic</td>
<td>N</td>
</tr>
<tr>
<td>(CHILLI, 2007)</td>
<td></td>
<td></td>
<td></td>
<td>Urban</td>
</tr>
</tbody>
</table>

Table 2-2 Commonly cited LBG’s and their relationship to play types and narrative.
It is possible to note that games with a ludic or hybrid purpose commonly include an embedded narrative and imaginative play types. It is also clear that many play types are under-represented. Since different play types may appeal to different children and their emotional needs, the inclusion of a larger range, including creative and constructive play are considered during design research. Another advantage of the search and find model, is that there is more scope for adding different play types at each of a series of locations. Different play types may appeal to different, emotional needs, therefore how such needs influence game success is considered next.

2.2.4.12. Proposed design guidelines:

- Include a range of play types in the game to appeal to different children.
2.2.5. Emotional needs and game success

Emotion has been argued to be at the heart of any human experience and an essential component during interaction (Forlizzi, 2004). From a psychological standpoint, emotion has three basic functions: to shape our plans and intentions, to organise the procedures related to the plans and to evaluate the outcomes (Carlson, 1997). For a game, it can also shape our interaction with other players and with the environment (Isbister, 2016). Malone suggests that emotion is what makes a game fun (Malone, 1982). Shigeru Miyamoto (the creator of Mario and Zelda series) designs his games around a series of specific emotional experiences. However, he also sees the individual player's relationship to the game as significant, thus requiring further understanding (de Winter, 2015). McGonigal suggests: “a good game can hold the attention of players for hundreds of hours and a study of the underlying emotions for the experience may help to understand their ability lure people away from real life for such periods of time” (McGonigal, 2010).

Freeman, who coined the term ‘emotioneering’, suggests that the narrative elements (graphics, characters and story-lines) are the most influential for the emotive aspects of games (Freeman, 2003); however, it has also been argued that emotions can be brought into games through the core mechanics (Areliusarson, 2013).

Rigby and Ryan (2011) identify a number of key emotional needs that must be represented to guarantee game success. Their conclusions are based on over thirty years of research into human motivation and psychological health, studying over 20,000 subjects across a range of game types. These researchers base their work on ‘self-determination’ theory (Ryan, 2006). They also explain that similar emotional needs apply to multiple domains of life, such as learning or work. The PENS group identified three primary categories of emotional need: competence, autonomy and relatedness. They also discuss ‘immersion’ but as more of a process of increasing the depth of experience, through visceral amplification through which to meet needs or a result of meeting them.
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**Competence/Mastery** refers to our innate desire to demonstrate skill, expand our abilities and gain mastery over certain challenges. This motive is evident from childhood when we overcome physical and linguistic challenges as we learn to walk and talk. Commonly, our power to overcome obstacles in the game environment is more evident than in real life. We can defeat the ‘baddies’, perform great feats of strength and even save other people from certain death or whole virtual worlds from extinction. Competence is likely to be a strong motivator for first-person shooter (FPS) games, such as ‘Doom’, platform games as in the ‘Mario’ series and task-oriented games including ‘Guitar Hero’. Rigby and Ryan (2011) also discuss the importance of ‘feedback’ on their success for competence needs.

**Autonomy/Control** refers to the need for freedom in action or alternatively to have a strong sense of personal volition towards the required action. This stems from an innate desire to act from our own choice, and not because we are controlled by other people or situations. Autonomy suggests freedom from constraints, but it also implies a strong sense of purpose, if the player is convinced about their plan of action. Autonomy is strongly represented, for example, in roleplay games where the player takes on a character with a mission or games with explorable worlds where several choices of destination are available.

**Relatedness** refers to our need to have meaningful connections with virtual characters in the game or other physical players. Rigby and Ryan (2011) discuss the notion of camaraderie or belonging. They further describe game scenarios where empathy with other characters is emphasised through the content and narrative or through the gameplay, such as by joining forces with others, either real people or characters, to achieve the objectives.

**Immersion** can increase the depth of experience and the impact of the three emotional needs by making the player’s role in the game more convincing. If the player is a virtual superhero, showing their competence by scaling tall buildings while following a path of action that will save their world and other characters, a strong sense of immersion helps to ensure that the player feels that they are
present within the reality set by the game. They also distinguish between physical presence and emotional presence when increasing levels of immersion.

2.2.5.1. Emotional Responses

Jegers, (2009) considers attributes of a game in terms of motivation:

**Challenge** describes how an activity needs to have a goal with an uncertain outcome; the player needs performance feedback about how close they are to reaching the goal.

**Curiosity** refers to how the system should be novel and surprising without being too complex: it should also include an element of randomness to make the environment optimally complex.

**Fantasy** relates to how the interface of the system must embody emotionally appealing fantasies: sensory stimuli (sound and graphics) should enhance the fantasy of the player.

Bateman, (2008) provides a longer list of positive emotions experienced by players during game playing. Some of these also correspond to the resolution of more negative states of mind. Data was gathered from 1040 respondents with their top 10 emotions, as shown below:

1. **Amusement**: creating humour through the game.
2. **Contentment**: fulfilling one’s expectations, based on performance.
3. **Wonderment**: where a game allows you to act in an out-of-character way. This may be, for example, through game ‘power-ups’.
4. **Excitement**: executed in the fight or flight response of the body and triggered commonly by potential threat, perceived harm or extreme action in the game.
5. **Curiosity**: a player’s natural curiosity to perform new actions or discover novelty.
6. **Fiero**: a personal triumph over adversity.
7. **Surprise**: heading towards an expected outcome and then exceeding it.
8. **Naches** is a Yiddish word describing the feeling of pride in the achievements of one’s mentees as we teach or guide others to success.
9. **Relief**: a natural result of the resolution of strife and tense situations when the threat has gone.
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10. **Bliss**: when effort is exerted, creativity is achieved, having socialised with others and from being immersed.

### 2.2.5.2. Emotions and player types

A user-centred approach assumes that different people have different needs, preferences and behaviours, leading to the existence of player ‘types’. (Bartle, 1996) was one of the first researchers to describe these categories alongside player motivation, as follows:

1. **Achievers** enjoy playing to win, typified by the desire to overcome challenges.
2. **Explorers** are motivated to interact with the game world and have a sense of discovery within it.
3. **Killers** prefer acting on other players to dominate or bully them through politics.
4. **Socialisers** prefer interacting with other players.

A later critique of these approaches by Dixon (2011) suggested that people can fit into several of these categories and may or may not be one predominant type. Lazzaro (2004), for XEODesign conducted a study entitled ‘Why We Play Games: the Four Keys’. The study examined player aims outside of the story through the game mechanisms: it also related these aims to desired emotions, the results are shown in Table 2-3.

<table>
<thead>
<tr>
<th>Aim</th>
<th>Player observations</th>
<th>Emotions generated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hard fun</td>
<td>opportunity for challenges.</td>
<td>Frustration and fiero.</td>
</tr>
<tr>
<td>Easy fun</td>
<td>intrigue and curiosity.</td>
<td>Wonder, awe and mystery.</td>
</tr>
<tr>
<td>The people factor</td>
<td>social interaction.</td>
<td>Amusement, schadenfreude and naches.</td>
</tr>
<tr>
<td>Altered states</td>
<td>An enjoyable internal experience.</td>
<td>Excitement and relief.</td>
</tr>
</tbody>
</table>

### 2.2.5.3. Discussion

To optimise an experience, research suggests that understanding a predisposition towards a game can enable a pre-emptive design approach...
(Areliusarson, 2013). Rigby and Ryan (2011), suggest that a successful game should be designed to meet a series of key emotional needs, including the ability to show competence or mastery, have a sense of autonomy and allow relatedness; they also suggest it should promote immersion, which deepens experiences.

The categories of motivation for pervasive games indicated by Jegers include challenge, curiosity and fantasy. ‘Challenge’ echoes the Rigby and Ryan concept of ‘competence; and curiosity/ fantasy are similar to concepts described under the category of ‘autonomy’. Jegers model lacks the reference to relatedness with characters or other players. Lazzaro’s model relates quite closely to the PENS model (Rigby and Ryan, 2011) as illustrated in Table 2.

<table>
<thead>
<tr>
<th>Lazzaro</th>
<th>PENS group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fun type</td>
<td>Player motivations</td>
</tr>
<tr>
<td>Hard fun</td>
<td>opportunity for challenges.</td>
</tr>
<tr>
<td>Easy fun</td>
<td>intrigue and curiosity.</td>
</tr>
<tr>
<td>The people factor</td>
<td>social interaction.</td>
</tr>
<tr>
<td>Altered states</td>
<td>An enjoyable internal experience.</td>
</tr>
</tbody>
</table>

Dixon (2011) would suggest that player types are an over-simplification as players can fit into more than one category. However, the types identified by Bartle and Lazzaro also echo similar themes to the PENS model.

- ‘Achievers’ seek challenges, as in Yee’s (2006) and Bartle’s (1996) models; those who seek Lazarro’s (2004) ‘hard fun’ also seek opportunities to test themselves. Seeking challenge can be related to the mastery/competence classification by the PENS researchers, Rigby and Ryan.
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- Explorers, in the Bartle (1996) model, have a sense of curiosity about the game world and characters; Lazarro’s (2004) ‘soft fun’ describes those who seek new situations and intrigue with curiosity. Freedom to explore new terrain and address player curiosity is also included in the need for autonomy/control, defined by Rigby and Ryan.

- Socializers/killers in the Bartle (1996) model could be seen as interactions with real or virtual characters on a spectrum from cooperative activity to competitive and even aggressive behaviours. Thus, these categories could also be reflected as a spectrum within the concept of ‘relatedness’ in the PENS model.

More detailed descriptions of emotional reactions, provided by Bateman (2008), represent player response to a game, rather than identifying and predicting key emotional needs as in the Rigby and Ryan (2011) PENS model. Nevertheless, there is some correlation between the detailed emotions noted and the PENS categories; possible correlations are indicated in Table 2-5. Bateman (2008) also recognises that game play can include negative emotions on the way to achieving game goals, frustration may be the opposite of fiero, for example and these are also indicated. They may also provide clues that help to recognise when emotional needs are unmet.

Table 2-5 How emotional response can correlate with predictive emotional needs

<table>
<thead>
<tr>
<th>Rigby and Ryan: Emotional Need to be met</th>
<th>Emotional Reactions (Bateman, 2008)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Competence &amp; Mastery</td>
<td>Excitement:</td>
</tr>
<tr>
<td></td>
<td>-state of arousal during challenging tasks</td>
</tr>
<tr>
<td></td>
<td>-opposite state is ‘boredom’. If boredom is prolonged this suggesting insufficient or un-appealing challenges.</td>
</tr>
<tr>
<td></td>
<td>Fiero:</td>
</tr>
<tr>
<td></td>
<td>-feeling of triumph after overcoming challenges,</td>
</tr>
<tr>
<td></td>
<td>-opposite reaction is frustration; if prolonged this may suggest challenges are too extreme.</td>
</tr>
<tr>
<td></td>
<td>Relief:</td>
</tr>
<tr>
<td></td>
<td>-relaxed feeling after overcoming challenges,</td>
</tr>
<tr>
<td></td>
<td>-opposite reaction is anxiety.</td>
</tr>
</tbody>
</table>
Autonomy

Wonderment:
- feeling of curiosity and intrigue
- without wonderment, the game is too predictable.

Relatedness

Amusement
- a shared joke with game characters or other people
The game context and audience will dictate appropriate jokes and levels of amusement.

Naches
- feeling of pride and supporting others
- the opposite feeling may be detachment from game characters or players.

Immersion

Bliss
- the feeling of being fully immersed.

The concept of contentment also mentioned by Bateman could be a reaction to either competence or autonomy as it describes success at achieving game goals, for example it could result after overcoming challenge or discovering new terrain and characters. Likewise, ‘surprise’ could be a reaction to unpredicted game features or achieving more than the player expected.

2.2.5.4. Implications for Design Research

The PENS model of emotional needs, created by Rigby and Ryan (2011) provides a predictive approach to addressing what the needs of the player may be, rather than describing a response to existing games and it can also encompass the definitions of emotions that others describe (Bateman, 2008; Lazzaro, 2008; Jegers, 2009). It will therefore be referred to when proposing design guidelines in this thesis. The category titles also have a more helpful, semantic meaning than those referred to by others, such as Lazzaro’s (2008) ‘hard fun’. However, the descriptions of emotional response can serve to add more detail to the PENS categories. Using ‘player types’ (Bartle, 1996) precludes the fact that players do not like more than one type of fun and thus is inappropriate for the game being created, which should appeal widely to children.

Key emotional needs for desired player responses are therefore investigated during this project, for PBMGs, via a participatory design process to support the
achievement of an ideal experience. The research examines appropriate challenges for the player, to promote feelings of competence, activities that can promote curiosity, exploration, or choice and investigates how social connections can be included safely. The altered states described as ‘immersion’ by Rigby and Ryan (2011) relate to the depth of the experience and provide a goal to be achieved. The difficulties of achieving this across real and virtual worlds will also require careful investigation.

2.2.5.5. Emerging areas for investigation

- How can we predict and address the emotional needs of the player for this context?
- How can game mechanics, narrative elements and reward systems promote feelings of easy fun (adventure & exploration, autonomy & choice) when playing PBMG’s?
- What level of ‘hard fun’ is appropriate to challenge the player and promote feelings of mastery and competence?
- How can immersion or an altered state be induced through the visceral, behavioural and social aspect of the game?

2.2.5.6. Proposed design guidelines: emotional needs

**Where competence needs are emphasized:**
- Allow the player to overcome challenges at an appropriate level, to feel a sense of mastery and competence.

**Where autonomy needs are emphasized:**
- Allow exploration and a sense of adventure through the discovery of new terrain and characters.
- Allow a feeling of choice through different possible actions.
- Create a sense of volition in the player through the game.

**Relatedness:**
- Ways of socially connecting the player should be considered: this could be through NPC’s.
2.2.6. Conclusions for LBMG’s and Game Design

LBMGs have the potential to raise awareness of a location, such as a natural environment, through the compelling media of a game, using digital enhancements. In order to direct an informal learning experience through a connection to place, a site specific, absolutely positioned LBMG is ideal: this was retitled a ‘place-based mobile games’ (PBMG) for simplicity. The ‘search and find’ and specifically a ‘treasure hunt’ style play pattern was found to be appropriate for connecting players with a physical space. This pattern also provides the potential to include a range of play types that will appeal to different players. Pragmatic game dimensions for this context of play will be considered through design research, including issues of duration, game sequencing and alternatives to interacting with other players. This, in turn, influences how activity is directed, how navigation is achieved and how this will be directed, through GPS locations.

The addition of a narrative with fantasy elements or storylines can be an effective way to engage people and address key emotional needs; a narrative can also help to create meaning and wholeness, connecting disparate tasks or game elements and can support educational goals. However, when fantasy elements of the virtual world are included in maps and key wayfinding tools, this can hinder progress and negate an awareness of surroundings; the connection with reality must be carefully managed.

In deciding the form of the narrative, game mechanics and reward systems, emotional needs as defined by the PENS group (Rigby & Ryan, 2010) for the PBMG will be taken into account. Aspects of competence, autonomy and relatedness will be considered to support the ideal experience and included in the investigations with children to investigate their validity. More detailed emotional descriptions can help to add further depth to understanding these primary categories.

Concepts of ‘immersion’ have also been discussed by Rigby and Ryan and others, they have also been considered similar to being in a state of ‘flow’, discussed in more depth during the following chapter section on theoretical
frameworks.

### 2.2.7. Summary of emerging areas for investigation

The following table summarises the issues that have emerged during this section of the literature review that require further investigation (key: I = investigate and G = games).

<table>
<thead>
<tr>
<th>IG1.</th>
<th>How can GPS reliability and other technical constraints impact on the experience of play for the natural environments under study?</th>
</tr>
</thead>
<tbody>
<tr>
<td>IG2.</td>
<td>How do the pragmatic dimensions of location, time and social interaction, influence the experience? Subdivided into:</td>
</tr>
<tr>
<td></td>
<td><strong>IG3.</strong> What kind of duration should the game and activities be, for this context?</td>
</tr>
<tr>
<td></td>
<td><strong>IG4.</strong> How does the sequence of activities and number of events affect the experience?</td>
</tr>
<tr>
<td></td>
<td><strong>IG5.</strong> How can a social dimension be safely added to an LBMG?</td>
</tr>
<tr>
<td>IG6.</td>
<td>How can attention be directed towards the real environment at appropriate times, so that the player feels connected with the physical world and learns from it?</td>
</tr>
<tr>
<td>IG7.</td>
<td>What kind of wayfinding tools, including maps, are appropriate for the audience and what is their relationship with reality versus fantasy?</td>
</tr>
</tbody>
</table>

**Emotional Needs:**

| IG8. | How can we predict the emotional needs of the player and include them in the game? |
| IG9. | How can the game promote feelings of mastery and competence? |
| IG10. | How can the game include aspects of autonomy, including adventure & exploration or choice? |
| IG11. | How can immersion or an altered state be induced through the visceral, behavioural or social components of the game? |
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2.2.8. Summary of proposed design guidelines (key: D = design and G = games)

DG1. The area should have reasonable GPS signal and sensitivity or use other locational means.
DG2. To lead players to specific areas of a landscape, with flexibility to add different play types, the ‘search and find’ pattern should be followed.
DG3. In order to direct players to specific features in a landscape, the game needs to be absolutely positioned to particular GPS points.
DG4. To direct players to learn about specific locations in the real world, the game should be site specific.
DG5. Plan in focus switches between the real and virtual worlds.
DG6. Reduce unnecessary features and distracting media, where possible.
DG7. For a game to achieve popularity, it helps if it is pervasive, so that it is always available to the player.
DG8. The ability to play the game multiple times can encourage repeated site visits.
DG9. The core game mechanics and narrative elements should relate to the emotional response of the player and should be appropriate for the intended audience.
DG10. A narrative should be included to set the scene for the game action and a premise to establish the overarching game goals; this may be in the form of a linear story or a more flexible narrative.

Competence:
DG11: Allow the player to overcome challenges at an appropriate level to feel a sense of mastery (hard fun).

Autonomy:
DG12: Allow exploration and a sense of adventure through the discovery of new terrain and characters.
DG13: Allow a feeling of choice through different possible actions.
DG14: Create a sense of volition in the player through key emotional needs.

Relatedness:
DG15: ‘Safe’ ways of socially connecting the player should be considered.
2.3 Children, Nature and the Context of Play

2.3.1 Introduction

This section of the literature review considers information relevant to the context of older children playing in natural environments.

The primary sections are:

2.3.2: Defining a real-world problem

Literature that points to the recognised decline of outdoor play in nature.

2.3.3: Why older children should play outdoors

Studies that illustrate the problems resulting from a lack of outdoor play. Defending the choice of older children as an audience to address these concerns.

2.3.4: Challenges to play in natural environments

Constraints that represent increased challenge for play in natural environments.

2.3.5: Non-digital ways to encourage play in nature

A study of how experts attempt to overcome challenges to play in natural environments related to suitable play types and emotional needs.

2.3.6 Digital applications related to children and nature

A review of research and commercial apps situated in natural environments.

2.3.7: The child and their ability to meet challenges

The cognitive, physical and emotional capabilities of older children.

The relationship between this part of the literature review and the whole study is shown in Figure 2-9, shaded in green.
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2.3.2 Defining a real-world problem

2.3.2.1 Recognition of ‘nature deficit disorder’

Statistical information gathered by Natural England (a UK government body responsible for matters related to the English countryside) serves to illustrate the disconnect between children and nature in modern times. Natural England surveyed 1050 adults and 502 of their children, aged between 7 and 11 across various socio-economic backgrounds and summarised their findings as follows (N.E., 2009):

- Less than 10% of children play in natural places compared to 40% of adults when they were young.
- 75% of adults claimed to have had a patch of nature near their homes and over half went there twice a week. 64% of children believe they have nature near their homes, but less than a quarter go there twice a week.

Other investigations by Natural England also corroborate this evidence (N.E., 2009a; N.E., 2009b; Wooley, 2011). Moss (2012) created a report for the National Trust (an organisation for the protection of British heritage and wildlife) that also reaffirms the existence of ‘nature deficit disorder’ with children, including a term originally coined by Louv (2005). Monbiot (2012) regularly writes for the Guardian newspaper: he claims that “if children lose contact with nature, they won’t fight for it”. The disconnect between children and nature has therefore also been discussed within mainstream media and is increasingly in the public domain.

The Wildlife Trust represents a leading NGO promoting biodiversity and is one of the organisations attempting to address ‘nature deficit disorder’. They organise conservation events for families, wildlife clubs for children and perform outreach activities with schools for varying ages (Wildlife Trust, 2014). The Sussex Wildlife Trust (SWT) were influential in the research for this project.

2.3.2.2 Defining a natural environment for the problem

The term ‘natural environment’ is sometimes associated with ‘wilderness’ and conjures up spaces in their original state without human inhabitants and human-related influence and impact (Carver et. al., 2001; Fjortoft, 2004). However, Carver et al. also suggest that this definition is irrelevant for present-day Britain,
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a place inhabited and modified by humans for millennia: they propose that the relativistic concept of the ‘wilderness continuum’ is much more apt since there is a true pristine wilderness at one extreme and a totally urban environment at the other.

Countryside at the wilder end of this spectrum has been highlighted as having the most benefits for physical and mental wellbeing (Fjortoft, 2001). Remote woodland, for example, has been shown to generate feelings of wellbeing and relaxation (Tabbush, 2003). However, the wilder the environment, often the less accessible it can be, an area that has a higher percentage of indigenous vegetation is likely to be perceived as more natural (Wooley, 2011).

The National Institute for Health and Care Excellence, in the UK (NICE, 2008), created recommendations, aimed at policy makers and health experts, directed at making natural spaces accessible. Their suggestions are to:

- Ensure that public natural spaces and public paths can be reached by foot, bicycle and other modes of physical activity. They should also be accessible by public transport.
- Ensure that open public spaces and public paths are maintained to a high standard. They should be safe, attractive and welcoming to everyone.

The SWT manage over 30 nature reserves in Sussex where they teach children and adults about nature and maintaining biodiversity. The spaces provide a range of habitats, with associated indigenous species. Most are accessible from urban areas, as per the NICE guidelines and are usually open to the public.

2.3.2.3 Discussion & Implications for research

Although the literature discussed represents selected evidence, rather than an exhaustive investigation, it corroborates the existence of ‘nature deficit disorder’ (Louv, 2005; N.E., 2009; N.E., 2009a; N.E., 2009b; Wooley, 2011). The directed efforts of SWT and other organisations have attempted to address the issues (Riley, 2007; Wildlife Trust, 2014). A natural environment for this research is considered to be sufficiently wild to promote wellbeing, with indigenous species present to afford learning (Rivkin, 1990; Groves, 2008), it should also be
sufficiently accessible and safe enough to meet NICE guidelines (NICE, 2008). SWT nature reserves are therefore deemed an appropriate site for investigations as they meet these criteria.

2.3.3 Why older children should play outdoors

2.3.3.1 Health benefits of natural play

An investigation by the Sustainable Development Commission (SDC), a public body responsible for advising the UK Government, indicated the health and wellbeing outcomes associated with use of outdoor spaces (SDC, 2008; DEFRA, 2010). Similar benefits have also been noted by independent researchers (Munoz, 2009; Pretty, 2009; Gill, 2011). A lack of outdoor play for children can therefore result in obesity and decreased mental wellbeing (Travlou, 2006; Juniper, 2013). Natural England also reported on benefits for wellbeing through education, independence and creativity (Wooley, 2011). Wells (2003) has shown that proximity to nature can act as a buffer to stress and improve concentration. The Forestry Commission in Scotland discovered that behaviour can be improved for children with mild-to-severe mental problems (Groves, 2008).

2.3.3.2 Awareness of biodiversity and environment

According to a report by the National Trust, many children are not able to identify common natural phenomena (Moss, 2012). Researchers have identified that childhood experiences of the countryside are crucial to knowledge about nature (Sobel, 2008). The correlation between an awareness of nature and a sense of environmental stewardship in adulthood has also been documented (SDC, 2008; Meech, 2014). In a report for the Children’s Play Council, it was stated that “contact with nature is directly correlated with positive environmental sensibility and behaviour late in life” (Lester & Maudsley, 2006). Moreover, research shows that visiting green spaces as a child leads to valuing them as magical spaces and encourages a lifetime habit of visiting nature (Bell et. al., 2008).

2.3.3.3 Why older children?

Bateson and Martin (2013) identified three stages of a relationship with nature in their studies, with a notable disconnect during teenage years:

- Aged 2 to 7: natural attraction or connection with the natural environment.
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- Aged 7 to 12: physical engagement with the natural environment.
- Aged 12 onwards: detachment from the natural environment with the development of socialisation.

In 2009, the Interdisciplinary Centre for Environment and Society (ICES) estimated that society could save over £2000 per person in healthcare costs if their recommendations for green exercise were followed, a key starting point was considered to be between 6 and 12 years (Pretty, 2009). A related fact may be that the phase before they enter teenage years involves key stages in their maturation as an individual (Zimmer-Gembeck, 2003). During this period, children begin to form opinions and broaden their understanding of the world (Galloway, 1996). A child’s cognitive ability to organise, rationalise and commit situations to long term memory, is more developed, permitting them to understand certain issues (Barroody, 2003; Hyson, 2003; Chalufour, 2004; Peterson, 2005; Hourcade, 2007; Pretty, 2009; Calfee, 2012; Costantino, 2015; Graham, 2015). Research carried out by DEFRA (2010) suggests that there is a particular correlation between connection with the natural world at this age and sustainable behaviour as an adult, which may be because this is a key stage of development. However, studies have shown that older students can be reluctant to visit the countryside, which is unfortunate given the significance of doing so, and that generally primary school students are more enthusiastic (Ballantyne, 2002.).

2.3.3.4 Discussion and Implications for Research

A range of literature sources suggest that the benefits of spending time in nature are well documented for the wellbeing of the child (Travlou, 2006; Munoz, 2009; Pretty, 2009; Gill, 2011; Juniper, 2013). There are also broader consequences for society due to the increased awareness of biodiversity and the way it depends on conservation (DEFRA, 08; Meech, 2014; DEFRA, 2014). Older children are more likely to remember their outdoor experiences and it is therefore suggested that there is a window of opportunity before teenage years to improve engagement with nature (Bateson, 2013). Wals, (1994) claims that we should engage with children to fully understand their perceptions of nature: therefore, a closer perspective will be gained through the design research process and working with children during this project.
2.3.4 Challenges to play in natural environments

To better conceptualise the factors that impact on individuals and their concern about global issues, like climate change or biodiversity, Barton (2005) created a ‘health map’ for human habitats (created originally for urban planners) shown in Figure 2-10. This has also been used to create a picture of the complex issues that prevent access to the natural world, including aspects of proximity, culture and social interaction. The model should be interpreted as a dynamic interrelation between certain different aspects.

- The inner layer focusses on people and the attributes of the individual: personal attitudes, lifestyle or education.
- Social capital refers to the influences of the local community and networks in society.
- Wealth creation involves the local economy and the roles that individuals play within it.
- Activities describe the actions and behaviours that link different aspects of the preceding layers.
- The relationship between the built environment and the natural world circles these factors.

A full understanding of the complexity of the many layers is beyond the scope of this research. Nevertheless, we can note the relationship between the individual
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and a connection to natural environments and the many layers of influence between them. Literature related to a connection with nature will be considered according to categories of influence.

2.3.4.1 People: the child’s concerns

Children have reported fears of natural spaces and have been shown to equate home with safety (Harden, 2000). O’Brien (2005) found that 8 to 10-year-olds have fears of such spaces, often linked to potential encounters with dangerous strangers. This could be associated with criminal activity from “rapists” and “paedophiles”, but also noted fear of teenagers behaving in a deviant manner.

2.3.4.2 People: the carer’s concerns

Carers are often influential in choosing children’s activities and are one of the key ways in which children are able to encounter wild spaces (Tandy, 1999). However, research also points to their influence as a major constraining factor on children’s outdoor play (Carver, 2001). There is evidence of a link between parental fear of outdoor spaces and a reduction in time spent outside by children (Gaster, 1991). (Groves, 2008) shows that this translates for some as anxiety over the “dirt” to the inherent physical risks. For others, it is manifested through concerns over ‘stranger danger’, which was the greatest fear for 98 percent of parents. According to Natural England, less than 10% of parents would allow their children to play in natural spaces unsupervised (N.E., 2009). Social and financial matters can also be an influence, and many families “cannot afford to leave the city” (Karsten, 2006). Thomas, (2004) reminds us that socio-economic status can be related to access to outdoor spaces, beginning with having a private garden. In a survey of mothers’ opinions as to why their children did not play outdoors, 85 percent identified their child’s television viewing and computer game playing as the number one reason (Clements, 2004).

2.3.4.3 Activities: resistance to wild spaces & other distractions

During research for a film documentary entitled: ‘Project Wild Thing’, David Bond (2012a) demonstrated that overuse of digital media was a distraction from active play outdoors in children. For some, the countryside was considered dirty, full of potentially harmful things or just boring compared with screen-based activity.
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These findings can be backed up by more statistical studies, Ofcom (2016) showed that for 8 to 11-year-olds, a total of 13.5 hours was spent per week watching television, 12.5 hours on the Internet and 9.5 hours on gaming. Childwise (2017), an independent marketing research company, investigated 2000 children aged 5 to 16; they were found to spend an average of six and a half hours a day in front of a screen compared to around three hours in 1995. In terms of the type of media: 32% of 8 to 11-year olds owned a smartphone; 44% have their own tablet; however, 57% have access to another phone at home; and 80% can borrow a tablet. The mobile phone was considered the most popular way to go online and access games and apps beyond the age of 11, over any other media.

2.3.4.4 Lack of access to natural environments

Children live within varying distances to natural environments, which influences their play habits (SDC, 2008). Children in urban areas were found to be less likely to play in natural spaces, due to a lack of access compared with children living in more rural towns. The report also concluded that there is little difference across the UK in trends towards playing in natural spaces across this urban and rural divide. In a study that interviewed urban children, some had a desire to engage in physical outdoor play, but they felt they lacked access to appropriate spaces in which to do so (Sandseter, 2009).

2.3.4.5 Discussion

The following table summarises aspects discussed here that deter children from outdoor play in natural environments; it also includes others from the broad literature search created by Natural England (Wooley, 2011).

<table>
<thead>
<tr>
<th>Influencing factors</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proximity and lack of easy access.</td>
<td>Cahill, 1990; SDC, 2008; Sandseter, 2009.</td>
</tr>
</tbody>
</table>
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|-------------------------|--------------------------------------------------|

The findings throughout this section, demonstrate that a child’s relationship to outdoor natural spaces varies according to circumstances, with notable differences in their perception of its qualities (Carver 2001; Barton, 2005; Thomas 2005; Karsten, 2006; Bond, 2012). This can be influenced by past experiences, which are also likely to depend on proximity, social background, financial influences, educational background and levels of previous access (Barton, 2005). Fears around safety and stranger danger are also indicated for both children and carers, who are still influential at this stage (Harden, 2000; Carver 2001; O’Brien, 2005. According to Ofcom (2016), Childwise (2017), Natural England (Wooley, 2011), Bond (2012) and Clements (2004), considerable time is spent on screen-based media, and this is seen as a distraction from other forms of more active play.

### 2.3.4.6 Implications for research

The issues that have been identified during this section represent levels of increased challenge and effort that would need to be overcome when attempting to increase volition to play in natural environments. Children from urban areas are particularly challenged. This suggests that children selected for the design research phases should come from varying backgrounds, circumstances and areas of a city as far as possible to reach the target audience. A survey to gather their pre-existing predispositions would allow for a comparison with the findings of broader national surveys as a control. Statistics about preferences for screen-based activity point to the use of smart phones and tablets as a valid medium to encourage children to visit nature.
2.3.4.7 Proposed design guidelines for further investigation

- Real hazards and safety concerns of within the natural environments should be mitigated for and information provided.
- Latent fears about natural environments should be addressed through a participatory approach to design.

2.3.4.8 Emerging areas for investigation

- How can children be safeguarded for outdoor play within an LBMG so that they and their parents feel they are safe?
- What particular techniques and activities do experts suggest will engage children with nature?
- Which aspects of the landscape are suitable and more enticing and how can they encourage play?

2.3.5 Non-digital ways to encourage play in nature

This section identifies some of the common activities proposed by experts to engage people and overcome challenges to play in natural environments. The purpose is not to provide an extensive study, but to pinpoint some typical tasks and play types for further investigation during design research.

2.3.5.1 Literature

Danks and Schofield (2010) wrote a series of books that describe tried and tested activities outdoors in nature with children. They include creative activities, such as using pigments from natural sources and sculptures from natural forms. Another of their publications (2009), covers survival-based activities: creating shelters, foraging and general bush-craft skills. Activities range from simple to quite skilled or complex to match a range of ages and can include the identification of flora and fauna through play. Robbs (2015) also wrote a book to make children aware of their place in the natural world, which includes similar creative and survival-based tasks but also rule-based games.
2.3.5.2 Online Resources

The SWT (2009) include a range of downloadable activity sheets for children and adults on their website. There are a range of constructive activities, from practical building projects (such as making a bat box) to more artistic tasks. They also include foraging activities and survival tasks (as in making nettle soup). There are exploratory activities to find creatures (for example, pond dipping), treasure hunts for particular objects or features (including identifying flora and fauna) and activities that involve nurturing wildlife (such as putting out feeders). The National Trust campaign, ‘Fifty Things to Do Before You’re 11¾’ includes a similar range of activities on their website. They differ by including a gamification component, allowing children to tick them off as they go. They also include sensory activities, such as “go on a walk bare foot, or hold a scary beast” (N.T., 2014; Paris, 2014). Activities are classified according to roles played by the child: adventurer (e.g. rolling down a hill); discoverer (e.g. having a snail race); ranger (e.g. making a grass trumpet); tracker (e.g. finding animal footprints); or explorer (e.g. canoeing down a river). The Woodland Trust (W.T., 2012) have a website aimed at children and teachers called ‘Nature Detectives’ suggesting a similar role play theme. Tasks occasionally employ fantasy elements to add another dimension to the activity, for example, in Figure 2-11, treasure hunts for natural phenomena are compared to ‘fairy-like’ objects, such as an umbrella (toadstool) or a hammock (feather).

![Fairy land hunt sheet](image)

Figure 2-11 Use of fantasy elements to make nature more fun
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The Woodland Trust (W.T., 2012) also added characterisation: children were asked to look for faces or make them out of found materials, shown in Figure 2-12.

Figure 2-12 Tasks to find or make faces of characters

2.3.5.3 Discussion and implications for research

Outdoor activities were investigated through a relatively small range of sources, yet common themes emerge. Most involve active exploratory engagement with the landscape through hands-on experience, encouraging interaction with natural phenomena. This suggests that similar activities could form tasks within the PBMG considered for this research, providing opportunity to look away from the screen during game play and encourage immersion in the physical world at relevant times. Creating an ideal balance of attention, avoiding excessive screen use has been highlighted as a key issue. Such activities could also introduce knowledge about flora and fauna, including identification of species. Further investigation into the validity of these assumptions is therefore required during design research.

The introduction of role play and an associated narrative, such as being a detective, or an explorer, adds an element of fantasy to the activities (W. T., 2012; N.T., 2014). Themes introduced around fantasy characters, fairies and pirates by the Woodland Trust also create an imaginary world, though these particular subjects were intended to appeal to younger children (W.T, 2012). Appropriate themes for the PBMG narrative should be investigated that are age and context appropriate, alongside how they are addressing key emotional needs.

Activities created by experts seemed to represent a range of different play types, previously discussed in section 2.3.4, such as creative play, exploratory play and
so on (Danks, 2009; Danks, 2010; Paris, 2014; N.T., 2014), table 2-7 provides some examples. Sensory play was used frequently by the experts (N.T., 2014; Paris, 2014) to immerse the child in the natural world and yet was not represented in the previous categories. Experts also introduced a form of nurturing play, where the child would support flora and fauna through their actions.

**Table 2-7: Play Types and Outdoor Activities**

<table>
<thead>
<tr>
<th>Basic play type</th>
<th>Example activities suggested by experts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional (physical) play</td>
<td>Locomotive play: tree climbing; rolling down a hill. Mastery: change the course of a stream; coppicing; object play.</td>
</tr>
<tr>
<td>Constructive play</td>
<td>Making homes for animals, as in bat boxes or bee hotels; den building; making grass trumpets; making bow and arrows from nature.</td>
</tr>
<tr>
<td>Imaginative play</td>
<td>Fantasy play: comparing nature with fantasy characters, fairies or pirates. Symbolic play: suggesting natural objects as props, such as stick as a person or creature. Roleplay: ‘being’ a warrior with a bow and arrow. Dramatic play: acting out what is required of being a ranger, tracker or explorer.</td>
</tr>
<tr>
<td>Creative play</td>
<td>Making art using pigments and dyes from nature; tree rubbings; designing jewellery from natural objects; making sculptures from mud; making music from nature; story writing.</td>
</tr>
<tr>
<td>Communicative play</td>
<td>Photography, art or exhibitions to communicate to others; descriptive writing.</td>
</tr>
<tr>
<td>Social and rule-based play</td>
<td>Games with rules, as in bat and mouse and snail races.</td>
</tr>
<tr>
<td>Exploratory play</td>
<td>Treasure or scavenger hunts for certain species, attributes or the colours of objects. Finding animal tracks, rock pooling, bug hunts to look for creatures.</td>
</tr>
<tr>
<td>Deep play</td>
<td>Survival as ‘bush-craft’ skills, such as foraging for food, lighting fires and creating shelter.</td>
</tr>
<tr>
<td>Sensory play</td>
<td>Walking barefoot, listening to birds, touching and feeling, using different senses.</td>
</tr>
</tbody>
</table>
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| Nurturing play (not previously identified) | Planting seeds, improving habitats and making shelters for animals. |

Including a variety of play types helps address different preferences and abilities. Choosing the search and find pattern for the PBMG, discussed in section 2.2.3, would allow a diversity of different activities and play types to be included at various locations within a PBMG. More investigation will be needed to check which activities are appropriate for older children and transferable to the game.

2.3.5.4 Key points: encouraging play in natural environments

- Activities in nature can relate to a range of play types and these could address different emotional needs and cover a range of preferences and abilities.
- Imaginative play opportunities are used by nature experts to make them appeal to the child’s imagination or to escape into the fantasy world presented.
- Nurturing play may improve ‘relatedness’ to the natural world.

2.3.5.5 Implications for research

2.3.5.6 Emerging areas for investigation

- Which activities, themes and narratives are preferable for older children and are transferable to a PMBG application?
- How can children be directed to particular natural objects and aided in identifying them within a digital game?
- Can the activities be classified according to play type and the ‘emotional needs’ identified as significant for game enjoyment and success?

2.3.5.7 Combining emotional needs and play types in nature

The following section suggests possible relationships between identified natural expert activities and emotional needs considered for games.

a) Showing competence:

Creative/constructive play, allowing the child to demonstrate abilities, for example: art with natural objects (S.W.T., 2009; Danks, 2010), building dens (Danks, 2009; S.W.T., 2009; N.T., 2014).
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Physical play challenges, locomotor activities: these are typified by the adventurer role in the National Trust campaign: rolling down a hill, climbing a tree and so on are present for most expert activity guides (S.W.T., 2009; N.T., 2014).

Collecting natural sightings/gamified versions: typical activities are treasure or scavenger hunts with an overall goal or a competition involved, such as ‘who can spot’ something first (W.T., 2012, N.T., 2014).

b) Increased autonomy or control:
Mastery play: examples involve control over nature: dam a stream activity (S.W.T., 2009).
Explorative play: certain activities within the explorer and discoverer role for the National Trust suggest autonomy over direction of play. Scavenger hunts and treasure hunts also require the child to freely investigate and find natural things, as in tracks (N.T, 2014).
Deep play- ‘survival’ themes: these allow children to appear grown up (in this case, self-sufficient) which relates to feeling in control. Similar themes appeared on the National Trust (2014) website, with ‘touching something scary’ providing an example of overcoming childhood fears and feeling in control.
Fantasy and role play: Narratives can be utilised to increase a sense of volition for activity and can connect disparate game activities with an overall theme (W.T., 2012).

c) Relatedness:
Symbolic play: some of the activities displayed a technique to add characters with human qualities, either by finding or adding them to the scene. This may have also given the scene more personality (W.T., 2012).
Nurturing play: this suggests a relationship to the natural environment, such as making a home for a wild animal (SWT, 2009).
2.3.5.8 Emerging areas for investigation

- Which of the activities normally conducted by wildlife experts are suitable for older children?
- What kind of characters and fantasy worlds do children of this age relate to?
- Which aspects of the natural environment do children prefer and why?

2.3.6 Nature & affordances that encourage play

Children will engage with certain aspects of their environment that are preferred (Fjortoft, 2001). A study by Wilford et al. (1988) noted that 53% of girls and 76% of boys spontaneously mention play with trees for: standing, climbing, hiding, becoming forts or bases, making dens and providing shelter. Bushes, undergrowth, corn, long grass and bales are also popular for hiding in. Further objects of interest include birds, animals, conkers, fallen leaves and water, which in the children’s view, “added an extra touch of magic to a play area” (Wilford et al., 1988). Titman (1994) discusses some of the environmental qualities that are appreciated by children, including: the colours of nature, trees, changing topography, shaded areas, and more generally how the environment encourages exploration and experience. Rivkin (1990) noted that nature appeals to a range of senses through smells from the vegetation, textures, sounds and so on. Novelty and unpredictability were qualities that were also valued. Wals (1994) found that pre-adolescents frequently perceive nature and describe it through positive adjectives, such as “alive, pure, peaceful, pristine, freedom, solitude, wild and spontaneous” (Wals, 1994). According to Wals, to understand more fully why particular spaces appeal to children, it is important to engage with understanding children’s perceptions of ‘nature’ and the ‘natural’.

Rivkin (1990) suggests that forms within the landscape can also have associative properties that are given meaning and that this symbolism can encourage dramatic play and a sense of ‘place-ness’. Others point to the importance of children being able to ‘claim’ spaces within natural areas, as “special” or “secret” and imbue them with their own distinct meaning (Thomas, 2004). Fjortoft (2004) describes how children named their favourite natural places, as in “the cone war” where pine cone throwing took place, suggesting children were creating their own
narratives. Certain researchers agree on the importance of studying the use of wild spaces in relation to the “micro-spaces” of children’s lives (Mathews, 1999; Mathews, 2000).

Scholars have emphasised how nature affords opportunities for children to explore, challenging them in the mastery of skills, and encouraging exercise through these persuasions (Grahn, 1997; Fjortoft, 2004). A ‘theory of affordances,’ is described in more detail in Chapter 2.4. In simple terms, it asks “how does what we see suggest possible actions?” For instance, how can the topography afford obstacles for children to overcome: the vegetation and trees suggest climbing; the meadows are for running and tumbling (Fjortoft, 2001). In a study by Moore, (1997) adults particularly remembered the landscape features that afforded play as a child, such as the stepping stones over the pond, and the trees they climbed. It is also helpful to consider the work of Heft, (1988) who classified the affordances of play, albeit for general outdoor environments, shown in Table 2-6.

<table>
<thead>
<tr>
<th>Landscape feature</th>
<th>Activities afforded</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relatively flat, smooth surface</td>
<td>Walking or running.</td>
</tr>
<tr>
<td>Relatively smooth slope</td>
<td>Rolling self or objects down a slope.</td>
</tr>
<tr>
<td>Graspable, detached objects</td>
<td>Drawing, throwing, hammering, batting, spearing, digging, cutting, tearing or squashing.</td>
</tr>
<tr>
<td>Attached objects</td>
<td>Sitting or jumping on, over or down-from.</td>
</tr>
<tr>
<td>Non-rigid, attached objects</td>
<td>Swinging.</td>
</tr>
<tr>
<td>Climbable feature</td>
<td>Climbing or looking out from.</td>
</tr>
<tr>
<td>Aperture</td>
<td>Looking or listening through it or squeezing through it if it is large enough.</td>
</tr>
<tr>
<td>Shelter</td>
<td>Sheltering from elements, hiding or being private.</td>
</tr>
<tr>
<td>Mouldable material</td>
<td>Construction or sculpting.</td>
</tr>
</tbody>
</table>
### 2.3.6.1 Discussion and implications for research

Natural environments offer complex playscapes, with a range of inherent physical and cognitive challenges that children can learn to overcome with practice (Wilkinson, 1980; Frost, 1992; Lindholm, 1995; Fjortoft, 2001). The child’s preferred aspects of nature appear to coincide with forms of play, for example: trees enable functional play and bushes suggest symbolic play (Grahn, 1997; Fjortoft, 2001). Affordances can help suggest possible actions, but they can also effectively challenge people to overcome them, providing a motivation for interaction (Heft, 1988; Fjortoft, 2001). There is also an association between affordance and memory: people remember the experience through the actions they performed (Moore, 1997). The landscape itself can be imbued with meaning for the child, through narratives and ‘special secret spaces’ (Titman, 1994; Mathews, 1999; Mathews, 2000). This is reminiscent of creative or roleplay activity (Rivkin, 1990).

Meanings associated with places and their consequence for play, may form part of a child’s motivation to overcome the physical and cognitive challenges during a PBMG and therefore their implications should be considered during design research.

### 2.3.6.2 Key points

- The terrain can require physical and cognitive effort to negotiate. However, it also offers challenges to the child to overcome effort.
- The natural environment offers affordances towards play, exploration and action within it, which can be motivational, instructional and enhance memory of an experience.
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2.3.6.3 Emerging areas for investigation

- What kind of activities & play types may be transferable to a digital game environment?
- How do the affordances in the landscape help to draw attention and motivate the child?
- How do the child’s physical and cognitive abilities match the challenges of the natural environment and a digital context?

2.3.6.4 Proposed design guidelines for further investigation

- Activities that direct children to interact with the landscape should be included in the game and promote immersion.
- In game tasks should be included from a range of play types that can match a range of preferences and abilities.
- Objects and places that have particular affordances and meaning for children are likely to be preferred and should be included.
- The game should address different emotional needs for different children, a narrative is a useful vehicle to support these needs.
- Competency needs can be addressed through physical and cognitive challenges.
- Free exploration of the landscape should be encouraged to promote autonomy.
- Forms of imaginary play should be included, to allow control over fantasy worlds.
- Alternative ways to promote relatedness should be considered, where peers cannot be present, such as nurturing play.

2.3.7 Digital applications related to children and nature

The following considers a sample of research based or commercial digital applications themed around nature. This is a representative sample of significant features based on their primary purpose that may inform the PBMG design.

2.3.7.1 Encouraging outdoor play in nature

The ‘Project Wild Thing’ project (Bond, 2012b) led to an associated App, ‘WildTime’, which suggests activities to be played outdoors from ten minutes to half a day. The tasks can be placed into categories similar to the literature for non-digital activity: creative, survival-oriented or sensory. The app has safety tips for being outdoors and a disclaimer included about participation. The National Trust
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also produced an app with the aim to promote countryside play. Activities are similar to their website or the non-digital tasks described in section 2.3.4.5. This app detects the season and can adapt its suggestions accordingly, such as “play in the snow”. To sign off each activity in turn, the child must describe what they did, where and who with. There is a basic reward system integrated to gamify the experiences; the child receives a certificate emailed to the parent when they complete a few tasks. Neither of these apps use location services or provide context-sensitive information.

One group of researchers sought to investigate the benefits of LBGs for formal learning about ecology. They were concerned that, without a human guide, the objectives of the lessons might not prove effective (Hsiao et al., 2010). They noted that mobile devices can improve learners’ motivation and encourage them to interact with context-sensitive materials independently. Research activities carried out as part of the Ambient Wood project also encouraged activity that was contextual in an outdoor natural space (Rogers et al., 2005). There was an aim to allow the switch from the ‘here and now’ of the physical world (when observing a butterfly drinking nectar from a thistle) to the ecological processes that lie behind it. Children were asked to explore the environment independently, initially by “looking, touching, smelling and listening”, leading to increased immersion and positive reports of enjoying the activity.

2.3.7.2 Discussion and implications for design research

The ‘WildTime’ and ‘50 Things’ apps provide a digitised version of nature-based activities, similar to the non-digital versions introduced by nature experts, discussed in section 2.3.5, demonstrating that the instructions for such activities can be communicated via a mobile device. Adding the likely duration of play and health and safety information was a useful addition, within these Apps, and similar information should be included for the game in this project. Participants in the Ambient Wood project and the studies with Hsiao et al. (2010) were able to find required locations without a human guide, which corresponds to the ‘search and find’ pattern of activity previously suggested in section 2.2 and suggests it is viable for this project. The independent exploration, facilitated by a mobile guide, was
found to be motivational, which may relate to feelings of autonomy, as referred to by (Rigby, 2011).

### 2.3.7.3 Species identification

In an article for the UK Daily Telegraph, the World Wildlife Fund (WWF) selected their top ten preferred apps for wildlife (Avery, 2015). Those selected were all field guides that help to provide functionality to identify species when mobile, without contextual awareness. They have varying degrees of depth in the level of information and variety of species addressed. The ‘Collins Guide to British Wildlife’ is a typical example, transforming the book of the same name into an interactive form. A screenshot of iBird is shown in Figure 2-13; it provides a relatively comprehensive identification guide and it has a range of different search attributes, range maps and playable calls for 283 species. Various research projects to consider mobile identification have also been carried out, including for bird watching and butterfly identification (Chang, 2003; Kao & Sheu, 2003; Chen, 2004).

‘Leafsnap’ is an example of an identification App that also includes visual recognition software, in this case to help identify tree species from their leaves. Similar developments with technology, were evaluated by Huang, (2010) identifying subjects semi-automatically, through the camera and image recognition. However, visual recognition software is still in its infancy at the time of writing.

Eliasson, (2011) illustrates how species identification can be gamified. Pupils aged between 10 and 11 identified individual trees by scanning a barcode. The students followed a trail of similar clues that eventually allowed them to reach conclusions about the forest type. Learning about the environment in this way was seen as an improvement over classroom techniques and found to be more enjoyable.
2.3.7.4 Discussion and implications for design research

A range of published apps and research projects have used identification methods similar to those in print and have also adapted them to formal educational experiences for children. The range of species and the depth of information about each can vary according to the audience and their requirements (Avery, 2015). For an enjoyable ‘hybrid’ game for young people, there is a limit to the volume of information that can be included, while maintaining its enjoyable qualities. Approaches to making identification more fun are therefore of interest for this project. Eliasson et al. (2011) included identification activities as intermediate tasks that led to an overall goal, thus gamifying the process. Activities introduced by nature experts in section 2.3.5 included identification activities informally, through play. Design research should therefore investigate the best way to create awareness of species, considering gamified or play based activities, without compromising the enjoyable qualities of the experience. Though object recognition could make the process of identifying more interesting, it is not yet sufficiently advanced enough to identify complex natural forms.

2.3.7.5 Spotting, recording and sharing information

Recording what has been found, either as an individual or competitively against others, is a typical activity within apps, sometimes alongside identification methods. iNaturalist is an example that facilitates meeting other nature lovers to increase learning and be sociable, screen shots shown in Figure 2-14.

![Figure 2-14: Screenshot from the Project Noah app](image-url)
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Photographs, commonly used when recording or sharing a find, can be tagged and positioned using GPS. There is a ‘collection’ facility for some, where the user can store and keep track of their finds (Avery, 2015). Recording and posting finds can contribute to crowd sourcing information to help with data around biodiversity; this can be a very efficient resource. Project Noah is such a programme; after taking photos of plants and animals, the user can submit the data for use by researchers and earn badges competitively. Project Noah describes its app as a tool to explore and document wildlife and as a platform to harness the power of “citizen scientists” everywhere (N.O.A.H, 2013).

2.3.7.6 Implications for design research

Encouraging visits to a website and having a social component fit the aims of this project. However, identifying the position of a young person publicly is not suitable from a safety perspective. Hence, further investigation into how the game can have a social component, while avoiding real world encounters with strangers will be necessary during the design research phase. Recording findings during site visits will also be considered.

2.3.7.7 Awareness of issues

The Open-Air Laboratory (OPAL) network is a UK-wide citizen science initiative that encourages being hands-on with nature for a variety of age groups and levels of ability (Bates et.al., 2015). Their app ‘Bugs Count’ supplies information about insects, but also promotes an awareness of climate change and how it affects creatures. Another example, ‘What’s Invasive’, attempts to employ users in a battle against non-indigenous species, illustrating how natural ecosystems can be disrupted: an example related to ladybirds is shown in Figure 2-15. The app and associated website help to create a community about this cause (MacKerron, 2013). Other published Apps relate to learning general ecological principles. iBiome-Wetlands, for instance, allows the application of biology concepts in a simulated wetlands environment to

![Figure 2-15 'What's Invasive' screenshot](image)
see the results of their actions on the environment (Studio, 2014). However, this is non-contextual and operates in a fantasy world.

2.3.7.8 Discussion & implications for design research

The examples show how young people can be made more aware of key environmental issues through digital media. There were also examples of using a creative or fantasy-based approach for children learning about their environment (Studio, 2014). These may appeal to the emotional needs related to autonomy and the use of a narrative may also increase the feelings of immersion in a situation, which may be experienced as positively engaging by the user (Rigby, 2011). How environmental issues can be included will also be investigated during design research phases.

2.3.7.9 Proposed design guidelines

- The interface should replace a human guide to direct the player to locations of interest.
- Activities should be presented within the appropriate context, providing the means and materials to be successful.
- The timing of activities and the game should be considered for the context, in relation to ability and preference and the player informed about duration.
- Methods to identify and increase awareness about species should be included to help develop a connection with natural phenomena.
- The volume and depth of information, e.g. the range of species and the amount of information about each should be appropriate for the audience and context.
- Activities included should be appropriate to the ability of the children.
- Contextual awareness should adapt to different seasons.
- Relevant safety issues about potential hazards should be included.
- Players, once in appropriate locations, should be encouraged to explore independently to promote feelings of autonomy and control.
- Gamifying the collection of information can promote feelings of ‘competence’ identified game experts.
- Feelings of immersion can be promoted by including a narrative within the environment.
2.3.7.10 Emerging areas for investigation

- How can the PBMG include safety information?
- What is the best way to include learning about species identification and environmental awareness?
- How do the child’s physical and cognitive abilities match the challenges of the natural environment and a digital context?

2.3.8 The child and their developmental stage

Understanding the child and their needs, related to their age and stage of development is central to addressing European standards for a user-centred design process (ISO9241). Development can be categorised into three main areas: cognitive, physical and social/emotional (Markopoulos, 2008). Cognitive development addresses the intellectual growth of a child, i.e. the way individuals learn to think, remember, problem solve and reason. Physical development deals with the development of motor skills as well as general coordination. Social/emotional development involves the formation of relationships with others and a child’s ability to understand, regulate and express their own feelings.

The players for this case are children aged between 8 and 12, aligning with the ‘concrete operations’ phase in Piaget’s developmental stages (Piaget, 1962; Piaget, 1983). In practice, this can include a range of abilities and behaviours. Some consider the idea of ‘stages’ as not always relevant. According to Markopoulos et al. (2008), physical development, for example, should be based on biological age, the size of the child, their natural movement skills and their levels of practical experience. With boys, progression through puberty is a major factor in strength (Markopoulos et al., 2008). These researchers claimed that we can only predict likely abilities and behaviours; however, some generalisations about developmental stages were considered useful. Children aged between 8 and 12 are able to understand hierarchies, which can enable them to use a greater variety of software than younger children (Hourcade, 2007). However, more abstract concepts such as deductive reasoning and logically analysing options appear more consistently during the later ‘formal operations’. Hence, screen representations need to be clear and direct, and required actions must be
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described precisely, rather than implied. The different categories of development will now be considered in more detail.

2.3.8.1 Physical development

Physical development will pertain to the child’s size, with associated anthropometric data for height, limb length and so on. Development will also consider their whole-body movements and their strength to carry out and maintain activities. Motor control refers to more refined movements, usually using the hands and fingers. The following table summarises the basic stages of physical development according to researchers, that may be relevant to the project. It references the work of a range of educational psychologists and Human Computer Interaction (HCI) experts working with children (Barroody, 2003; Hyson, 2003; Chalufour, 2004; Hourcade, 2007; Calfee, 2012; Costantino, 2015; Graham, 2015).

<table>
<thead>
<tr>
<th>Physical Aspect</th>
<th>Capability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor control</td>
<td>• Finger control is as refined as most adults.</td>
</tr>
<tr>
<td>Larger muscle groups</td>
<td>• As capable of many physical activities as adults, e.g., tree climbing, sports or lifting depending on size, body weight and practice.</td>
</tr>
<tr>
<td>Stamina</td>
<td>• Can run and walk further than their younger counterparts; however, levels of energy and patience must be monitored.</td>
</tr>
</tbody>
</table>

Chiasson and Gutwin (2005) discuss motor control. They interpret the developmental stage of a child into guidelines for design across different technology and claim that touch screens are the easiest for children to use.

2.3.8.2 Discussion and implications for research

According to experts, for this developmental stage, children with normal levels of physical ability can take part in a range of activities, at a level of challenge similar to adults (Barroody, 2003; Hyson, 2003; Chalufour, 2004; Hourcade, 2007; Markopoulos, 2008; Calfee, 2012; Costantino, 2015). Their ability to respond will depend on their physical size and other anthropometric dimensions more than
their chronological age. This suggests that most children chosen for this project are capable of responding to the affordances offered by objects within a natural environment. There is also a cautionary note that the child’s level of stamina in relation to the length of physical activity required must be considered. In terms of motor control, touch screens are an appropriate platform for children, thus supporting the use of smart phones and iPads as a starting point for the project.

2.3.8.3 Cognitive development
Since cognitive development affects communication, language and literacy considerations are important for digital development. Most children, including older ones, are less fluent with text-based media than adults (Chiasson et al., 2005; Markopoulos, 2008). Digital libraries have been investigated for children, and it was shown that entering text to do a search was not desirable, and that a more graphical approach was preferable (Druin, 2001). Chiasson and Gutwin (2005) consider the use of visual or audio clues as preferable when conveying information or instructions to children.

At this stage, children are developing reasoning skills, which will improve their understanding of the activities required of them, compared with younger children, however, they can struggle with tasks that require several steps to accomplish or which are performed infrequently (Gillibrand, 2016). It has been suggested that children need more prompting through a process than adults after a study working with 10 to 13 year olds to develop a collaborative activity for handhelds (Danesh, 2001). Druin (2005) showed that children between 5 and 10 may have difficulty with abstract concepts. They can understand icons that represent what animals eat, where they live and their appearance, thus connecting complex ideas, but were unable to think of search terms without these prompts.

Chiasson and Gutwin (2005) argue that children, particularly, have less patience when viewing the results of their actions and prefer immediate feedback. They also like a lot of feedback, and although constant visual and auditory feedback is often annoying to adults, it is not the case for children.
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Table 2-8 provides a summary of basic points made by researchers, about cognitive development for children that are relevant to the project (Barroody, 2003; Hyson, 2003; Chalufour, 2004; Hourcade, 2007; Markopoulos, 2008; Calfee, 2012; Costantino, 2015; Graham, 2015; Gillibrand, 2016).

Table 2-10: Cognitive Development at 8 to 12 years

<table>
<thead>
<tr>
<th>Cognitive Aspect</th>
<th>Capability</th>
</tr>
</thead>
</table>
| Language: reading & screens | • Reading narratives and stories can be of interest, but for more limited duration than most adults.  
|                           | • For screens, reading large amounts of text and complex words is not straightforward.  
|                           | • Remembering letter or text sequences is not ideal.  |
| Language: conversation    | • Almost adult level.  
|                           | • Statements or instructions can be delivered via video or audio media at almost adult level of complexity.  |
| Aptitude                  | • Beginning to get competent in certain areas & skills (and therefore have preferences for particular subjects & activities).  |
| Thinking & reasoning      | • Thinking is more organised and logical and thus seeks to understand the reasons for things.  
|                           | • Weighs options and makes decisions more efficiently than when young.  
|                           | • Asks increasingly complex questions that show she has given the matter some thought.  
|                           | • Understands that unforeseen factors may interfere with activities.  
|                           | • Can understand hierarchies and reverse actions  |

2.3.8.4 Discussion and implications for research

When considering the use of media for the game, it is important to avoid an overuse of text with a preference for audio and visual communication. Issues of patience arise in relation to reading long narratives and may apply to game content (Chiasson & Gutwin, 2005; Markopoulos, 2008). Children of 8-13 show
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more advanced reasoning skills than younger ones and have the ability to comprehend more complex menu systems and content for digital media (Druin, 2001). However, these factors should be tested through design research for this particular application.

2.3.8.5 Emotional development

According to Markopoulos (2008), also referencing Bronfenbrenner (1979), theories that refer to both social development and emotional response are the most useful for children. This was also influenced by Vygotsky’s (1978) model in which the child acts on the context and the context acts on the child also cited by Seeley Brown (2003). Erikson’s work (1950), also cited in Mooney (2007), is of particular interest as it considers the question of the developmental stage at which certain emotional needs emerge. In particular, the desire for control, overcoming challenges and demonstrating competence, can be noted. During ages 5 to 11, Erikson suggests children also begin to develop a sense of pride in their accomplishments and abilities, adding that those who receive positive feedback are encouraged and develop a feeling of competence and belief in their skills.

Del Vechio (1997) discusses key emotional needs for children in more detail for the design of games and toys. He suggests that children between 5 and 11 still lack full control over their lives, yet they feel the desire to make more decisions for themselves, be more autonomous and generally have more control. He mentions the need to fit in with peers as being particularly strong, to counter their previous heavy dependence on parental attachment. This, together with hormonal changes, also accounts for a lot of ‘pushing boundaries’ behaviour. Further, he suggests that designs for children should include choice to allow for desired autonomy (especially for girls) and should also allow them to feel powerful. The need to overcome childish fears, such as the dark, ghosts or ‘creepy crawlies’, is also considered significant in making them feel more powerful. He describes the scenario in which children cannot have control, and thus they prefer to retreat into fantasy worlds where they can be more autonomous. Children are also considered to enjoy showing off their level of ability, physically and mentally, and their bravery or mastery during an activity.
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The following table summarises findings relating to social and emotional development, based on work by a range of academic psychologists (Barroody, 2003; Hyson, 2003; Chalufour, 2004; Hourcade, 2007; Calfee, 2012; Costantino, 2015; Graham, 2015).

Table 2-11 Emotional Development at 8 to 12 years

<table>
<thead>
<tr>
<th>Emotional/Social Aspect</th>
<th>Capability</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Engagement</strong></td>
<td></td>
</tr>
<tr>
<td>Initiative towards task</td>
<td>1. Requires less direction from adults and displays higher levels of self-reliance. Consequently, they desire more autonomy in their activities.</td>
</tr>
<tr>
<td></td>
<td>2. Is comfortable solving problems with peers.</td>
</tr>
<tr>
<td>Persistence</td>
<td>3. Can continue to pay attention during activities, compared with younger counterparts, even those that may not be particularly stimulating.</td>
</tr>
<tr>
<td>Curiosity</td>
<td>4. Participates in a variety of independent and peer activities.</td>
</tr>
<tr>
<td></td>
<td>5. Still enjoys learning new activities but is occasionally anxious about trying an activity perceived as difficult. Selects favourite activities and prefers to stick with those.</td>
</tr>
<tr>
<td>Creativity &amp; imagination</td>
<td></td>
</tr>
<tr>
<td>Creativity</td>
<td>6. Has an increasingly creative set of problem-solving strategies.</td>
</tr>
<tr>
<td></td>
<td>7. Other factors can diminish creativity at the later stages of this age group, like ‘copying what others do’.</td>
</tr>
<tr>
<td></td>
<td>8. Offering a wide range of new experiences can encourage creativity.</td>
</tr>
<tr>
<td>Imagination</td>
<td>9. Known to engage in themes of pretend play associated with real-life situations.</td>
</tr>
<tr>
<td></td>
<td>10. Roleplay themes tend to be more grown up than in primary years.</td>
</tr>
<tr>
<td>Social development, emotions and preferences</td>
<td></td>
</tr>
<tr>
<td>Peers</td>
<td>11. Increased influence of peer pressure.</td>
</tr>
<tr>
<td></td>
<td>12. Can be embarrassed easily by activities that seem too childish in front of peers.</td>
</tr>
<tr>
<td></td>
<td>13. Often develops close friends (usually of same sex).</td>
</tr>
</tbody>
</table>
### 14. Favours group play, clubs and team sports; wants to feel part of a group.

**Mood**

15. A characteristic of this phase is to be sensitive and overly dramatic.
16. Emotions change quickly and can be extreme, especially approaching adolescence.
17. Sometimes pushes the boundaries with parents to assert their independence and to feel in control.

**Behaviours and preferences**

18. Activities that can make them feel more grown up are enjoyable, e.g., using a mobile phone.
19. Can be obsessed with and motivated by money as it represents adult independence.
20. Prefers to make decisions about activities or things.
21. Satisfaction from finishing things and a sense of achievement.
22. Likes to appear able and competent, so responds well to encouragement for any activity.

---

2.3.8.6 **Discussion and implications for research**

**Physical development and needs:**

The physical development of the child should be considered for the design, including size (for example when considering spaces to enter and branches to reach) and strengths (for example when picking up a rock safely). The children should be able to physically respond to the affordances offered in the natural environment, evaluated through design research. The duration of each activity and the whole game length, involving walking certain distances, should also be evaluated. The findings again suggest that the use of smart phones and iPads would be suitable.

**Cognitive development and needs:**

In terms of cognitive development, older children should have suitable reasoning and comprehension skills to understand the game. The cognitive ability of the
child to ‘wayfind’ in such a location should be considered, and how they interpret the affordances and feedback in the game and physical environment.

**Emotional development and needs:**
This stage of development leads to specific emotional needs. Children are making the transition from high levels of dependency on a carer to relative freedom, while seeking validation from their peers. This can manifest itself as a strong need for control and autonomy, also cited as a key emotional need by Rigby and Ryan (2012). Allowing decision-making through exploration, or choosing options is therefore considered ideal. Children also like to show their competence and to develop mastery over physical and mental activities. To this end, they are likely to persist longer than younger children and also be embarrassed to take on tasks that they are not familiar with in front of others. The need for encouragement is particularly high at this stage (Hyson, 2003; Chalufour, 2004; Hourcade, 2007; Calfee, 2012; Costantino, 2015; Graham, 2015). This could come in the form of feedback about their success in the game tasks completed and the form it takes. Since, according to Rigby and Ryan (2012) addressing key emotional needs is key to game success, understanding how this applies to children of this age will be the subject of considerable scrutiny through participatory methods.

### 2.3.8.7 Key points: developmental stages

- The user’s stages of physical, cognitive and emotional development should be taken into account when designing for any audience. The child’s needs and abilities will be different from those of adults and should therefore influence the game requirements for this context.
- Key emotional needs emerging from the literature expand on those investigated by the PENS group who research them specifically to ensure game success.
- Frequently the child’s needs relate to their desire for more independence and freedom from parents, to appear more ‘grown up’, push boundaries, to demonstrate their abilities and to be accepted by peers.
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2.3.8.8 Emerging areas for investigation:

**a child’s developmental stages**

<table>
<thead>
<tr>
<th><strong>Physical ability</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>What level of physical challenge is appropriate for children of this age?</td>
</tr>
</tbody>
</table>

**Cognitive Ability**

- Which activities meet the level of cognitive development in this context?
- How do certain media types correspond to the child’s cognitive abilities in this environment?

**Emotional Needs**

- How can the emotional needs of the child be addressed for this context of play?
- How can the child’s need for independence be applied safely in this environment?

2.3.8.9 Proposed design guidelines:

**a child’s developmental stages**

<table>
<thead>
<tr>
<th><strong>Physical development</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Consider heights, limb sizes, movement capabilities, strength etc. for the audience when designing physical activities.</td>
</tr>
<tr>
<td>Evaluate stamina for the physical actions required and longevity.</td>
</tr>
</tbody>
</table>

**Cognitive development**

- Minimize the need to read on screen and use language of an appropriate level for all audiences.
- Consider the use of audio or video to deliver instructions for all audiences.
- Consider the ability of the audience to rationalize and understand the reason behind game principles.
- Allow the player to demonstrate their skills in key areas of choice.
- Consider ability to pay attention to multiple stimuli.

**Emotional development**

- Allow autonomy and self-reliance for older children and adults.
- Include activities to promote creativity.
- Where role play is included, ensure themes are appropriate.
- Consider game rewards that provide positive feedback.
- Include a variety/choice of activities that can match the abilities of the audience.
2.3.9 Conclusions for children, nature and the context of play

In this section of the chapter, it was demonstrated that despite known benefits for the wellbeing of children, there is a lack of outdoor play in natural environments, leading to a disconnect in the relationship between children and nature, described in the media as ‘nature deficit disorder’. There is evidence that this is also detrimental to society in general. Considering preferred alternative forms of play, particularly playing games on mobile phones, it can be concluded that LBMG’s are a suitable platform for digital interventions.

Factors that might hinder outdoor play in nature include (lack of) proximity to natural environments, concern about safety from both parents and children and distractions from screen-based media. However, as risk can be positive and some of the dangers are statistically unlikely, such factors should not deter people but should instead be mitigated for. The literature indicates that care must also be taken to target children from a range of backgrounds and different locations within an urban setting and to consider safety issues. The relative safety of Sussex Wildlife Trust nature reserves lead to the decision to use them as investigation sites for this research.

The natural environment contains innate physical challenges and makes different cognitive demands to navigate it compared with urban streets. Information about the physical and cognitive development of the child help to ensure that the challenges are within their abilities. It is important to consider certain affordances within the landscape that can indicate possible actions, motivate children and help them to remember play experiences. In addition, matching the ability, preferences and emotional needs of the child through a focused design research investigation is key.

Attempts have been made to engage young people with natural environments, through the work of nature organisations and NGO’s. Often the kind of activities they introduce require exploration and interaction with the landscape, introducing facts and identification of features and, as such, can promote immersion in the
surroundings. Such activities can also represent a range of play types that appeal to the different preferences and abilities of children. Certain Apps have attempted to communicate outdoor tasks, suggesting it is possible to communicate instructions through the screen. However, so far, interactive activities in nature have not been included as part of a mobile game, with an associated narrative and overall goal. A ‘search and find’ pattern allows the inclusion of activities across a range of play types to be included within the same game. It will therefore be important to consider how to include typical outdoor activities through a game narrative and to ensure that both are age appropriate and meet the emotional needs of the child.
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2.3.10 Summary of emerging areas for investigation

Labelled I (investigate) and C (context)

| IC1. | What are the best ways to safeguard children for PBMG play and promote feelings of safety for children and their parents? |
| IC2. | Which activities & play types that engage children with nature can transfer to a PBMG? |
| IC3. | Which aspects of the landscape are enticing and can encourage play, through their affordance, for a PBMG? |
| IC4. | How can relatedness and a social component be included in the game without compromising safety? |
| IC5. | Which outdoor activities and play types can be employed to engage older children with nature and transfer to an PBMG? |
| IC6. | What kind of themes, characters and narratives do children of this age relate to? |
| IC7. | How do the child’s physical and cognitive abilities match the demands of this environment and game context? |

Physical ability:

| IC8. | What level of physical challenge for activities within the game and duration of effort is acceptable for older children? |

Cognitive Ability:

| IC9. | What level of cognitive challenge for activities within PBMGs is acceptable for older children and how long can they concentrate? |
| IC10. | Which media are appropriate to the child’s cognitive abilities in this environment? |
| IC11. | What kind of identification tasks and information about nature are appropriate and relevant for this age group? |

Emotional Needs:

| IC12. | How can aversions and challenges to outdoor play be overcome by positively addressing the emotional needs of the child to increase their volition towards the activity (through activities, game design, characters, narratives and themes)? |
| IC13. | How can the child’s need for independence be allowed safely in the game for this environment? |
| IC14. | What are the children’s existing habits and feelings around nature and the natural environment? |
2.3.11 Summary of proposed design guidelines

Re-ordered according to user-centred needs, labelled D (design) and C (context)

**Pragmatic Considerations:**

DC1. ‘NICE’ guidelines should be followed to identify appropriate sites: the site should be free of traffic and other major safety issues, such as cliffs or large bodies of water; the site should be accessible through local transport or a reasonable walking distance.

DC2. Other hazards within natural environments (identified by experts) should be mitigated for and information provided.

DC3. Activities should be included that promote interaction with the landscape and immersion through a range of senses.

DC4. Methods to identify and increase awareness about species should be included to help develop a connection with natural phenomena.

DC5. The interface should replace a human guide and direct the player to locations of interest.

DC6. The child’s and parent’s fears about outdoor play in natural environments should be addressed through an empathic, participatory approach to design.

DC7. The timing of activities and the game should be considered in relation to ability and preference and information provided.

DC8. Player’s level of experience in natural terrain should be taken into account.

DC9. The game challenges should address the developmental stage of the player.

The latter guideline is expressed in more detail through DC 10-15

**Physical challenge:**

DC10. A game that requires walking in mixed terrain requires a threshold of normal physical ability for the developmental age.

DC11. Different physical play types should be included, where considered safe by experienced nature guides.

DC12. Consider ability for the physical actions required and longevity of the task.

**Cognitive challenge:**

DC13. The game should not exceed a threshold level of cognitive ability for the developmental age of the player.

DC14. The volume and depth of information should be appropriate for the audience and context.

DC15. Minimize the need to read on screen and use language of an appropriate level for all audiences, consider alternatives of audio or video.
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**Experience Based Considerations**

DC16. Objects and places that have meaning and affordance for children are likely to be preferred and should be included.

DC17. The game should include a range of activities that address different play types, abilities, preferences and emotional needs.

*Emotional Needs are broken down into more detail through DC18-26.*

**Emotional Needs: Relatedness**

DC18. Alternative methods to promote relatedness should be considered, where interacting with humans is a safety consideration.

**Emotional Needs: Competence**

DC19. Competency needs should be addressed by having challenges in the game at an appropriate level of physical and cognitive development.

DC 20. Gamifying the collection of information can promote feelings of ‘competence’

DC 21. Consider game rewards that provide positive feedback for children.

DC 22. Allow the player to demonstrate their skills through a variety of activities that can match the abilities of the audience.

**Emotional Needs: Autonomy**

DC 23. Players should be allowed to explore independently to promote feelings of autonomy.

DC24. Forms of imaginary play should be included to allow feelings of control in fantasy worlds.

DC25. Where role play or narrative are included, ensure themes are appropriate (e.g. feelings of being grown up).

DC26. Include activities to promote creativity.
2.4. Theoretical Frameworks

2.4.1 Introduction

This section of the literature review discusses the theory and principles that can support the development of PBMGs.

*The primary sections are:

2.4.2 Experience-based design

Expert definitions of an ‘experience’ and the discipline known as ‘experience-based design’.

2.4.3 Interaction design principles

Principles of interaction design, usually related to communication between people and technology. Considering how they could also include relationships between people, technology and places.

2.4.4 Optimal experience, flow theory and game design

Evidence for the use of flow theory as a theoretical framework to support the design of an ideal gaming experience.

The relationship of this section to other sections of the literature review is illustrated in Figure 2-16.

![Figure 2-16: Theoretical frameworks: flow and interaction](image)

2.4.2 Experience-based design

Dewey (1938) distinguished everyday experience from a special experience, which he suggested would have a clear beginning, an end and be memorable. Design researchers have repeatedly attempted to model such experiences, including the context of use or situation of play. Attempts to address the
experience of using a digital system, and the ensuing emotional responses, were introduced over a decade ago (Alben, 1996; Forlizzi, 2004). During this time, the MIT Media Lab began a study on affective computing (Picard, 1997) in which the level of engagement with an interface became significant. This has since been described as experience design (Shedroff, 2001). It has also been labelled experience-based design to take account of the fact that the user’s interpretation will always be a part of the experience, and that designers are never fully in control of the result (Sanders, 2002).

The term user experience (UX) design has become associated with a movement, alongside a philosophy and set of practices. UX design has subsequently become an umbrella term for a series of distinct disciplines and methodologies that can include, branding, marketing, competitor analysis and technical considerations, besides the consideration of interaction design and affective properties (UX Organisation, 2013). Interaction design is a related activity within UX that focusses on the relationship and dialogue between humans and technology, which is where the focus for this project lies. These movements have also seen corresponding developments in human-centred design methodologies to support the development of ideal digital experiences. These are discussed in more detail in Chapter 3, which analyses previous research relevant to developing the methodology for this project.

2.4.2.1 Goals for interaction design

Preece et al. (2015) have identified a series of Interaction goals to guide the development of digital interfaces. They further separate them into usability goals, where the designer is attempting to optimise pragmatic interactions between people and technology and experience-based goals, which relate to the quality of the interaction.

Usability goals suggest that interaction with an interface should be: effective (identified goals can be achieved); efficient (the user’s time is not wasted); safe (hazards are not created or are overcome during use); have good utility (allow the right kind of functionality); learnable (users can quickly work out what to do) and memorable (users can easily remember what to do) (Preece et al., 2015).
However, they also point out that these goals are most appropriate for functional, task-based activities, such as in the workplace. Moreover, interaction for entertainment, as in games, can appear to conflict with the purpose of usability goals. For example, though players need to be able to achieve the in-game tasks (making the game effective), they may not do so as rapidly as possible (thus lacking efficiency).

Experience-based goals are defined by Preece et al. (2015) as intended to create an experience that is satisfying, enjoyable, fun, entertaining, helpful, motivating, aesthetically pleasing, supportive of creativity, rewarding and emotionally fulfilling. However, the work of some games researchers suggests that these categories can be seen as an over simplification. Rigby and Ryan (2012) claim that the desire to play for ‘fun’ is a rather inadequate interpretation and, on occasions inaccurate. This is because games are a serious business for some, involving strategic action, stressful situations and even fear; describing this as fun is at the very least ambiguous (Ryan et al., 2006). An extreme example is found in the genre of ‘serious games’, where the game ‘Darfur is Dying’ is based on the genocide in Darfur, using the formal and dramatic elements of games to engage players (Ruiz, 2006). In addition, the experience of a game has been described as that which arises during interaction, rather than being ultimately definable (Salen & Zimmerman, 2003). The designer does not directly create the experience, but they create the elements of the game, which the player inhabits, explores and manipulates to form their individual experience.

2.4.2.2 Interdependence between usability and experience goals

Usability and experiential goals have been considered by some researchers as co-dependent. Overbeeke (1999) discussed the idea of making interaction a more fun and beautiful experience. He emphasises that although usability is important, it is also vital to include emotional considerations because if we pay attention when designing to how users feel about an interface, it will inevitably be more usable. For Jordon (2002), although the more pleasurable qualities of a design directly influence the experience of interaction, meeting the requirements of functionality and usability will still be fundamental. He likens this to Maslow’s
hierarchy of needs where self-esteem and actualisation can only be met once we have addressed our physiological, safety and social needs (Jordan, 2002). This is illustrated in Figure 2-17. Positioned in this way, usability is subsumed by the experience.

Figure 2-17 Jordan’s illustration of pleasure based on Maslow’s hierarchy

An alternative term ‘playability’ has been used in association with games. It has been found that “playability is the instantiation of the general concept of usability” (Fabricatore et al., 2002). Playability has also been argued to consist of pragmatic and experience-based considerations when referring to a game (Nacke, 2009). The connection between usability and affective properties was also explored by the author, through the design of games, described in a paper appended to this thesis, appendix 1, item 8.2.1 (Grundy & Blake, 2007).

2.4.2.3 Discussion and Implications for Research

Several researchers point to the interdependence of usability and experiential goals and suggest focusing on pragmatic and affective concerns together when designing interaction (Overbeeke, 1999; Jordan, 2002; Grundy and Blake, 2005; Norman, 2005; Meyer, 2017). The interdependence between usability and experiential goals will therefore be assumed for this project. The broader definition of UX, as a discipline, also considers the appeal of the game in terms of its imagery and narrative, often related to branding; this can also be significant in player response. Though an exhaustive study will not be possible within the remit of this research project, imagery and themes that are acceptable to the audience will be established.
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The work of Rigby and Ryan (2012) suggests some experiential goals can have limitations, they propose that meeting key emotional needs is therefore more important. Interaction design principles introduced by Norman (2005, 2013) can help to meet interaction goals for an interface and will therefore be scrutinised next.

2.4.3 Interaction design principles

Interaction Principles can be categorised under the titles: attention, affordance, visibility, feedback and consistency (Norman, 2013). They are described in more detail below, with examples of application to games.

2.4.3.1 Attention

According to Norman (2013), attention should only be drawn to important features of a design because our ability to pay attention to multiple stimuli is limited. Attention and how it relates to memory have been described as: “the focusing of mental resources onto a particular object or task” (Norman, 1969). Norman (2013) also suggests that attention takes mental effort and our ability to concentrate on an array of things is thus limited. The limits to our attention are dictated by the amount of effort our brains are able to expend, described as our ‘cognitive load’, suggesting that our brains can only do so many things at once. He therefore claims that the designer should direct attention in the best and most meaningful way. Cognitive Load Theory relates this issue to educational applications, developed by psychologist John Sweller (1998). Processing new information results in ‘cognitive load’ on working memory which can affect learning outcomes. Takatalo (2007), a games researcher suggests:

We perceive the world around us by attending to the features and events that interest us. Lots of environmental stimuli are perceived but only a small proportion of this is interesting enough to draw our attention and become the content of our experience.

There has been some agreement that the structure of awareness and the subsequent focus of our attention can include a motivational component, a cognitive interpretation and emotional attitudes towards the information being
observed. This became known as the trilogy of mind, a term coined by Hilgard (1980), involving will, cognition and feeling.

2.4.3.2 Relationship to games

In Chapter 2.2.3.14, having to balance attention between the virtual and physical world was found to be a critical issue. In extreme cases, this led to potential danger from hazards in the real world for games like Pokemon Go! (Molloy, 2016) due to distracting media and fantasy worlds. For LBMGs, Ritchie (2014) describes the presence of simultaneous events that require attention in the context of using virtual media across physical spaces. On the one hand, successive experiences evolve over time and space in the digital world; on the other, the physical environment enables the audience to receive information from a variety of stimuli.

Cole and Stanton (2003) compared the projects they contributed to: KidStory, Hunting the Snark and Ambient Wood, and they reported problems with shifting attention away from the technology, due to it showing a continuous flow of information. In the Caerus project by Naismith, Sharples and Ting (2007), users were moving around a botanical garden. However, the focus on the guide was reported to be a problem, due to the mental effort required to use the application and navigate the space. Frohberg, Goth and Schwabe (2009) studied 38 mobile learning projects; for 28 of them, the mobile technology was reported as too dominating. The specific digital aspects that were seen to add distraction were animations, moving images and excessively confusing features. The conclusion was that elements such as these should only be added where they add value and are significant to the purpose of the presentation at a given point in time. Schwabe and Goth (2005) proposed a series of guidelines to counteract this particular problem: 1. Plan in the focus switches (direct attention between virtual and real worlds when appropriate) to the activity; 2. Use the technology only when it adds value; 3. Do not use animations if the application is meant to be in the background; 4. Reduce features as much as possible.

2.4.3.3 Discussion and implications for design research

A range of research projects have found that participants focus too much on a screen, rather than on the surrounding landscape (Schwabe & Goth, 2005;
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Frohberg et al., 2009; Eliasson et al., 2011). This has been due to distracting media, too many features, including a flow of information and the mental effort involved in understanding instructions, navigating and looking at the map.

Hence design research for this project will consider how to direct attention appropriately so that an awareness of the landscape can be achieved while playing. Optimisation of cognitive load (Sweller, 1994) for critical moments in finding directions and getting instructions for game goals will be necessary.

2.4.3.4 Proposed design guidelines

<table>
<thead>
<tr>
<th>Attention balance</th>
</tr>
</thead>
<tbody>
<tr>
<td>The player's attention should be balanced appropriately to allow awareness of the real world and focus switches included in the game plan (Frohberg et al., 2009).</td>
</tr>
</tbody>
</table>

Reduce the cognitive effort for the screen-based activity

- Do not use animations or moving images if the application is meant to be in the background (Frohberg et al., 2009).
- Reduce unnecessary features as much as possible (Frohberg et al., 2009).
- Ensure that way finding activities do not require excessive attention and demand on the player's cognitive load (Naismith et al., 2007).

2.4.3.5 Affordance

Objects should project appropriate affordances to indicate possible actions and meanings to the user (Norman, 2013). Norman describes ‘affordance’ as a relationship between the object and the person, conveying how they could interact with it. The psychologist Gibson originally introduced the concept and defined it as “action possibilities’ latent in the environment, independent of an individual's ability to recognize them”. Subsequently, Norman (2013) adapted the concept for design, however, he suggests that affordance can also depend on a person’s capabilities; though a chair affords support to most people, it only affords the action of lifting to those who have the strength to do so.

2.4.3.6 Relationship to games

In Chapter 2.2.4.1 on narratives, we saw that Ritchie (2014) suggested that certain spaces can help to construct a story depending on how the player’s...
perception and movement are controlled. He describes how paths, spaces and other objects perceived can support a narrative by affording or constraining, revealing or concealing information (Ritchie, 2014). In Chapter 2.3.4.10, we discussed how nature affords opportunities for children to explore their physical abilities, challenging them towards the mastery of skills (Fjortoft, 2004).

### 2.4.3.7 Visibility and signifiers

The possible actions available with an interface should be obvious to the user. To be effective, affordances should be easily visible to the person concerned. Norman (2013) defines the term ‘signifier’ to indicate where a point of interaction should be more precisely. For example, a visible or discoverable area on a screen ‘signifies’ that a user should click on it and generates an affordance, communicating a possible action to the user. Signifiers are sensory cues that add visibility to help the player understand the actions that are possible and which lead to an affordance (Norman, 2008). The concept of indicating what is possible through affordance, communicated through visible signifiers, is described by Norman (2013) as ‘feedforward’.

**Signifier types:**

‘Signifier’ is a term originally discussed in the field of semiotics, the study of signs. Saussure is credited with being the father of the theory and was published posthumously through “A course in General Linguistics” (Saussure, 2013). He describes two elements of a sign: the signifier or rather the object, and the ‘signified’, which is the picture created in the mind of the viewer. Charles Sanders Pierce, who also created foundational theories in semiotics, introduced three possible relationships between a sign and its object, thus helping to view and use signs practically, cited by Liszka (1996):

- **An index sign** has an indicative relationship between the signifier and the object. For example, an arrow indicates the direction of suggested travel.
- **A symbolic sign** has a learned or culturally understood relationship. For instance, a red light means ‘stop’.
- **For an iconic sign**, the signifier has a tangible resemblance to the object; for example, a child’s teddy has a resemblance to a real bear.
2.4.3.8 Visual composition:

Historically researchers have argued that visibility and the way our attention is directed can be influenced by the visual properties within an environment (Graves, 1951). Visual elements provide the basic building blocks from which all forms are made; they include dots, lines and basic geometric shapes. We exert different amounts of physiological effort when we look at different shapes. When processing a horizontal line, our eyes are required to move in one dimension only. When we see a diagonal line or a curve, however, we are moving our eyes along two sets of coordinates, and we make more cognitive effort. Theoretically, as shapes become more difficult to see they are visually provoking, the more likely they are to draw our attention, depending on the surrounding environment; this is illustrated in a representation of a city skyline in Figure 2-18.

One could also argue that there are no absolute qualities of shape, and that they are always influenced by the optical environment. Contrast becomes an important factor in which certain elements are perceived as more striking; this is known as increasing the visual weight, and is influenced by relative size, colour, detail, brightness and boldness.

2.4.3.9 Relationship to Games

When moving around a game space, signifiers can help direct attention to areas of interaction and indicate what should be done with the objects encountered (Christine, 2016). Secret City Adventures are the creators of immersive game experiences with real props and provide an illustration of how different signifiers have been employed in games (Christine, 2016).
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Figure 2-19: ‘Panic Room Door’ designed by Secret City Adventures

The door they created for a panic room representation, shown in Figure 2-19, exhibits all three types of Pierce’s sign/object relationships. Firstly, the whole form resembles a door that might be found in a nautical submarine style environment (an iconic sign); secondly, the round wheel indicates that the player must turn it (an index sign); the yellow and black warning sign indicates a possible hazard and that the player should proceed with caution (a symbolic sign). Using visual properties, to direct players around an adventure game, was the subject of an author (Grundy, 2005) see Appendix, item 8.2.2. The results showed a correlation between visually striking elements and the players’ ability to spot important features. A design by game designer, Seth Brown (Grundy, 2007) provides an example: he used circular forms and areas of brightness to create a contrast and to draw the eye. A screen shot of this is shown in Figure 2-20.

Figure 2-20: Adventure Game experiment using visual weight to guide the player
2.4.3.10 Discussion and implications for design research

Affordance has been noted as playing a motivational role in the virtual (Mateas, 2001) and physical worlds (Fjortoft, 2004), challenging participants to continue with their quest. Affordance has also been seen to play a role in helping to tell a story through the environment and the information found within it (Ritchie, 2013). The role of affordance should therefore be considered through design research, for both the virtual and physical worlds to guide attention, direct players and motivate them to action.

Associated signifiers are the means by which affordances are made visible to the player, drawing attention to the environment or the next required action. Visibility can be enhanced by using different sign types, icon, symbol or index. In Chapter 2.3.4.10, it was suggested that forms within the landscape can have *associative* properties that are given meaning (akin to the use of metaphor or iconic signs) such as ‘faces’ being seen in the knots on a tree (Rivkin, 1990). Thomas and Thompson (2004) point to the way that children view spaces as “special” or “secret” and so imbue them with their own distinct symbolism (symbolic signs). Fjortoft (2001) describes how trees afford climbing; their branches and form indicating particular places to hold feet or hands (index signs). Ritchie (2014) also alludes to the potential for affordances and constraints in the environment directing (or indicating) activities, and how the narratives behind it suggest interpretations as index signifiers. Feedforward, affordance and visibility through signifiers, will be further evaluated through design research for this project, noting the preferences of the child and which elements of the landscape they pay attention to. How these aspects and the visual element influence visibility for wayfinding will also be important and will be investigated.

2.4.3.11 Emerging areas of research

- How can feedforward and the meaningful affordances be used to motivate players to pay attention to the environment?
- What kind of role does affordance play in communicating directions and desired actions through signifiers?
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2.4.3.12 Proposed design guidelines

- The game should use feedforward, visible signifiers and affordances in the virtual environment to instruct players and guide their activities.
- The game should take account of visible signifiers and affordances in the physical world that impact on play.

2.4.3.13 Feedback

Feedback describes a response to the actions of the user to let them know what actions have been performed, which is achieved by transmitting appropriate signals. It is described by many HCI experts as being fundamental to interaction, ensuring the participant is aware they have performed the right or wrong action (Preece, 2000; Preece et al., 2015). However, it also plays a more affective role (Norman, 2013). Cooper (2003) suggests that most of us view technology as having human characteristics, and feedback is a part of a dialogue as if one is having a conversation with the interface. Murphy et al. (2013) suggest that game activities must provide a lot of feedback about progress, and this should be immediate as part of their moment-to-moment actions and behaviours. For a game, feedback can vary from a character on screen moving left after pressing the left control, or a device vibrating to indicate a collision to positive or negative feedback about progress. Feedback can also take the form of in-game rewards. It has been shown that the reward and goal systems offered by games are a key part of their motivational value, which is why they are leveraged for educational and serious games (McGonigal, 2011).

2.4.3.14 Discussion and implications for design research

Chang (2003) demonstrated that child learners, in particular, expect and want immediate feedback from learning systems. Mobile learning researchers have shown that contextual awareness can support learners’ needs of immediate feedback about a subject (Chang, 2003; Chen et al., 2003; Chen, 2004; Hsaio, 2010). The Ambient Wood project (Wilde et al., 2003; Rogers et al., 2010) illustrates the positive aspects of instant feedback by making experiences more significant. The system they designed provided biological information, in situ, for real physical natural objects.
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However, it was noted in Chapter 2.2.3.2 that GPS is used primarily to provide feedback about location. This becomes more complex with the added physical aspect to the game, accounts of frustration due to slow GPS response or signal blackouts are known to be an issue (Jacob, 2011).

There are different types of feedback to be considered for PBMGs. These include contextual feedback about a subject being explored; ways of indicating successful navigation to a location through signifiers in the landscape; compensating for GPS signals when wayfinding; reward systems and progress against intermediate and overall goals. These aspects will be further investigated through design research.

2.4.3.15 Emerging areas of investigation

- How can contextual information influence feedback about location and experiential learning about content?
- How does poor GPS response impact the experience?

2.4.3.16 Proposed design guidelines

- Players should receive immediate feedback on their actions.
- Players should receive both positive and negative feedback on their progress.

2.4.3.17 Consistency & conceptual models

Designs should keep working models, navigation and screen layouts consistent throughout a design (Norman, 1969; Norman, 2002). When driving a new car for the first time, the controls are likely to be relatively consistent with previous models and only require a minimal period of adjustment. Similarly, different games designed to be played on a certain console usually default to the same controls for similar actions. If a game feature, menu item or point of interaction is not where we expect it to be, we might feel a sense of confusion or annoyance (Blake, 2006).

An interface should also be consistent with showing a positive ‘compatibility’ between our expectations and what happens when we perform an action. This is discussed by HCI experts such as Norman (2013) and Jordan (2002), but it is also referred to in general ergonomic textbooks (Grandjean & Kroemer, 1997). For a
game, if we press a control that indicates movement to the right, we would expect the avatar or camera to move right.

We tend to naturally create a mental model of how something will work; consistency can also be interpreted as maintaining this likely model in our minds (Norman, 2013). Mental models can expand to complex concepts, such as the way a game is structured, what the game goals are and what the intermediate tasks are to achieve them. Norman’s (2013) studies have also shown that we find it much easier to comprehend items with a connected meaning than a series of arbitrary ones.

2.4.3.18 Relationship to PBMGs

De Souza e Silva and Frith (2014) discuss location-based narratives in a city environment. They claim that referring to different locations through a cohesive narrative allows them to become connected in the audience’s mind and form a meaningful whole, effectively representing a conceptual model of the tour. A better understanding of location can be gained through relational information to other places and the story being told, providing feedforward information about spatial relationships. When evaluating an experiential game model, it has been found that the story behind a game can create a framework and clarify the goals of the game (Kiili, 2006). A project called ‘Environmental Detectives’ used probes and AR to investigate fictitious toxins in the landscape, providing a narrative to encourage engagement with the environment (Klopfer, 2007); this helped to combine the activities into a meaningful mission.

2.4.3.19 Implications for research

The examples above illustrate how the narrative can help create a conceptual link between potentially disconnected activities or locations. The narrative can be in the form of core game mechanics and it can show how intermediate goals relate to the overall goals, or it can be in the form of a story that links meaning in the player’s mind. The design research in this thesis will consider preferred ways to make these connections through co-design activities.
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2.4.3.20 Emerging areas for investigation

- How can the design address the conceptual model in the mind of the player?
- How can the narrative provide meaningful connections in the mind of the player between the characters, activities and game goals?

2.4.3.21 Proposed design guidelines

- Specific tasks should add up to an overall goal (Eliasson et al., 2011).
- The game narrative can connect different content, activities or locations and help to create a meaningful whole (a conceptual model) in the mind of the player.
- The game should be consistent with player expectations in its control, game play and adherence to the conceptual model formed.

2.4.4 Optimal experience, flow theory and game design

2.4.4.1 Why flow theory as a framework?

As discussed in the introduction chapter, a range of theoretical frameworks to address designing an ideal experience for games have been considered. Flow theory, originally introduced by Mihaly Csikszentmihalyi (2002), has been recognized as a useful model for predicting an ideal game experience (Sweetser & Wyeth, 2005; Chen, 2007; Murphy et al., 2013) making it supportive of arriving at design guidelines. Further evidence for it being a suitable model for this work will emerge as its qualities are examined in this section.

Murphy et al. (2013) suggest that the qualities defining flow for games are a sense of timelessness, being at one with the activity, experiencing exhilaration, focus and immediacy, which are ideal requirements. These authors further suggest that “the intense feelings of engagement, discovery, and learning we experience during flow are a core part of the appeal of” (Murphy et al., 2013). As Chen (2007) argues:
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Flow explains why people prefer certain games more than others and how they become addicted. If a game meets all the core elements of Flow, any content could become rewarding, any premise might become engaging. (Chen, 2007)

As game designers, the question is not whether flow is important, but rather how long you can keep your players in flow (Chen, 2007).

2.4.4.2 Defining flow and its prerequisites

The concept of flow for any activity can be split into the following series of attributes, also illustrated in Figure 2-21:

- **Achievable goals**: we can do the activity or can hope to with time.
- **Clear goals**: the activity has tangible, well communicated goals.
- **Affords concentration**: the activity draws our attention, and we are able to concentrate on it.
- **Feedback**: the activity has direct and clear feedback.
- **Control**: we feel that we are in control of the activity, the choices we make and the outcomes.
- **Worries disappear**, other worldly concerns are secondary to the activity.
- **Alters perceived time**: subjective experience of time is altered.

Although the flow model does not explicitly illustrate relationships with other people, Czikszentmihalyi (1990) acknowledges the significance of human contact; he suggests that we are “biologically programmed to find other human beings the most important objects in the world”. Other people and external
influences can order our attention, keeping us from ‘psychic entropy’, a state he defines as the opposite to the ordered consciousness present with a flow state. On the other hand, focused attention can be disrupted by others.

2.4.4.3 Applying flow to games

Sweetser and Wyeth (2005) created a model of how flow corresponds to games, called the GameFlow model. An interpretation of this is shown in Table 2-12. Their model is general, and they invite others to create genre specific versions of it.

<table>
<thead>
<tr>
<th>Flow theory</th>
<th>Games design</th>
</tr>
</thead>
<tbody>
<tr>
<td>An activity that can be completed.</td>
<td>The overall goal for the game can be completed.</td>
</tr>
<tr>
<td>An activity that has clear goals.</td>
<td>The game should have clear goals (that is overarching goals and intermediate goals or tasks).</td>
</tr>
<tr>
<td>The ability to concentrate on an activity.</td>
<td>The ability to concentrate during the game.</td>
</tr>
<tr>
<td>An activity that provides immediate feedback.</td>
<td>The game gives immediate feedback.</td>
</tr>
<tr>
<td>The ability to exercise a sense of control over actions.</td>
<td>Players should feel in control during the game.</td>
</tr>
<tr>
<td>A deep but effortless involvement; concern for self disappears; sense of time is altered.</td>
<td>A sense of Immersion.</td>
</tr>
</tbody>
</table>

Murphy et al. (2013) attempt to categorise the elements of flow specifically for games into the prerequisites for attaining the flow state and the benefits of being in a state of flow. Conditions to be met include: an appropriate level of challenge; clear game goals, promotion of concentration and focus, and the provision of feedback; these are shown in blue in Figure 2-22. Subsequently, the characteristics of flow, which result from the prerequisites being met, are: feelings of control, diminished awareness of self and an altered awareness of time, as shown in green in Figure 2-22 (Murphy et al., 2013).
2.4.4.4 Discussion and implications for design research

Flow attributes have been separated into prerequisites for the flow state and the results gained from meeting these prerequisites (Murphy et al., 2013). This suggests that if particular properties of a design meet the prerequisites the designer is supporting an ideal experience. For example, the game may be designed to be at an appropriate level of challenge, allowing a feeling of control to appear as a benefit. However, Rigby and Ryan (2011) consider that feelings of control can also be designed into a game, through pre-emptively addressing the key emotional need of ‘autonomy’. Mechanisms include: adding a sense of volition, choice, the ability to explore and other devices.

Similarly, affording concentration, according to Norman and others can be influenced by drawing attention appropriately when designing an interface. Several potential mechanisms for achieving this are possible, including those discussed in the section on ‘feedforward’, using affordance and related signifiers.

Creating a balance of attention across the virtual and physical worlds has been highlighted as a key issue for PGMG’s. If we consider that ‘affording concentration’ is critical to flow and an ideal experience, divided attention is potentially a threat to this state. This also supports the rationale to use flow as a model for this project as it represents an ideal and highlights where potential issues need to be overcome. How appropriate attention is supported and divided
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over the real and virtual worlds therefore requires detailed investigation during design research.

As a consequence of these observations and to ensure the flow model is useful for supporting the creation of design guidelines for all relevant factors, the illustration in Figure 2-23 shows a revised version of Murphy et al.’s (2013) diagram, that will be referred to during this research. ‘Controllable’ and ‘Affords Concentration” are unclassified as a prerequisite or benefit, indicating they may require attention for design during this project. The specifics of a flow state will be discussed in more detail in the following sections.

2.4.4.5  Appropriate level of challenge

A critical aspect of flow is that the activity is achievable and matches the level of ability of those involved (Czikszentmihalyi, 1990). For games, the analogy would be to provide an *appropriate* level of challenge for the player (Murphy et al., 2013; Sweetser & Wyeth, 2005). The level of challenge depends on the difficulty of the overall goal and the intermediate goals compared to the past experience and innate aptitudes of the player.

Outside of the ideal range of responses, anxiety (too challenging) or boredom (too little stimulation) will occur, illustrated in Figure 2-24.
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Frustration will occur if the player cannot progress beyond a certain point in a game but, if the game is too easy, there will be no feeling of achievement. Provided other conditions are met and the challenge is balanced against skill and time, players can experience flow (Murphy et al., 2013). Sweetser and Wyeth (2005) also suggest that a perceived or imagined challenge is important. They translate the flow attributes of challenge for games as design guidelines in Table 2-13 (Sweetser & Wyeth, 2005).

Table 2-13 Design guidelines: challenges and goal setting (Sweetser and Wyeth, 2005)

<table>
<thead>
<tr>
<th>Flow for games</th>
<th>Proposed design guidelines</th>
</tr>
</thead>
</table>
| Challenge      | • The game should match the player’s skills during the activity to enable effortless involvement, but also to provide a challenge.  
• Games should provide new challenges at an appropriate pace.  
• The players perceived skills should match challenges and exceed a certain threshold. |

2.4.4.6 Discussion and implications for design research

In Chapter 2.2.5, it was suggested that PBMGs present a relatively high level of challenge due to the requirement to negotiate both physical and virtual worlds (Ritchie, 2014). In Chapter 2.3.3.6, social and cultural challenges to playing in a natural environment were noted for children due to personal fears, their pre-
disposition, social or cultural issues and proximity. The natural terrain also presents a greater challenge to negotiate than urban environments because of its lack of structure and physical demands. The incidence of affordance and feedforward within the landscape were also claimed to direct the player in an activity and to motivate them to overcome particular challenges by Fjortoft (2001). Thus, it can be noted that the notion of feedforward also plays a role in setting appropriate levels of challenge.

In Chapter 2.2.3.3 on LBMGs and motivation, the desire to overcome challenges that are within our capabilities was considered a key factor in the need to play games (McGonigal, 2011; Pearce, 2011). Previous research pointed to the emotional need to feel a certain sense of competence when overcoming challenges (Jegers, 2007; Rigby & Ryan, 2011), leading to feelings of fiero, according to Lazzaro (2004). Meeting other key emotional needs, including autonomy and relatedness will also be important in order to drive players to overcome challenge. To optimise a flow state, it will, therefore, be important that levels of challenge are appropriate to the audience and that sufficient motivation to overcome these challenges is created by addressing the key emotional needs and considering affordances. These matters will be considered through participatory design research.

The consideration of challenge as a key factor throughout the literature further points to the validity of flow theory as a valid framework.

### 2.4.4.7 Issues for further investigation

- How can inherent challenges be overcome for PBMGs that might interfere with the flow state?
- What are the key emotional needs of the audience for PBMGs and this context that need to be addressed to overcome challenges?
- How can feedforward, affordance and signifiers help to reduce the challenge of playing PGMGs?
2.4.4.8 Proposed design guidelines

- The game should match the player's skill during the activity to enable effortless involvement but also provide challenge.
- Players should be motivated to overcome certain challenges inherent within PBMGs through addressing key emotional needs.
- Affordances within the landscape should be used to instruct and motivate players to overcome challenge.

2.4.4.9 Clear goals

According to the original descriptions of how to promote flow, an activity should have clear goals (Czikszentmihalyi, 1990). For a game, this would mean having a clear overall game goal, but also clearly communicated intermediate tasks leading towards the overall goal. Game mechanisms for introducing and directing the player towards goals vary from direct instructions to more subtle cues as part of a narrative, leaving the player to work out what needs to be done. Part of the enticement of a game for a player can be to work out what is expected of him/her. This needs to be carefully balanced against offering an acceptable level of challenge if understanding what is required is also part of that challenge.

The flow attributes of clear goals for games have been translated by Sweetser and Wyeth (2005) as design guidelines, as in Table 2-14.

<table>
<thead>
<tr>
<th>Flow for games</th>
<th>Proposed design guidelines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clear goals</td>
<td>Overriding goals should be clear and presented early. Intermediate goals should be clear and presented at appropriate times.</td>
</tr>
</tbody>
</table>

2.4.4.10 Discussion and implications for research

Earlier in this chapter, the relationship of intermediate tasks to the overall game goal was discussed, and how the whole game model forms a conceptual model in the player's mind of what is to be achieved (Norman, 1990). In Chapter 2.2.4.1,
it was shown that a narrative can connect disparate game elements through their meaning, and effectively support a conceptual model where the narrative provides a structure and justification for the game goals (Ritchie, 2014). Effectively, it creates a gestalt from otherwise random elements, and this is helpful to the player. How this is to be achieved will be considered through the design research.

In Chapter 2.3.6, the developmental stage of the child was discussed. The goals for a PBMG will need to be communicated in a way that is appropriate to the context and the audience. For example, reading text on a screen is never ideal, according to the research discussed in Chapter 2.3.6.3, but while a person is in transit, text is likely to be even more difficult to assimilate. The use of media will need to be evaluated during the design research to make goals clear.

The game goals can also be communicated in terms of key emotional needs, as discussed in Chapter 2.2.4.7 (Rigby & Ryan, 2012). For example, if presenting overall goals to appeal to those with competence needs, the instruction might be to “save the world”. For those who have a stronger need for autonomy, “explore the world and find…”. By appealing to those with relatedness needs, an instruction could be “save the people of …”. Similarly, intermediate tasks can also follow key emotional needs. For instance, competence could translate as “scale the obstacle”; autonomy needs could be “choose which character to talk to”; and relatedness needs could have the instruction “save your friend [and] kill the baddie”. How and when key emotional needs might be addressed for this context will also need to be evaluated through the design research.

2.4.4.11 Proposed design guidelines

- Overriding goals should be clear and presented early, including reference to any key emotional needs being addressed, e.g., for competence, ‘save the world’; for autonomy, ‘explore the world’.
- Intermediate goals should be clear and presented at appropriate times, including reference to the key emotional needs being addressed, e.g., to suggest competence, “scale the obstacle”; autonomy, “choose which path to take, etc.”.
2.4.4.12 Emerging areas for investigation

- What kind of game goals, overall and intermediate, can be understood by the player for this context?
- How can key emotional needs be addressed through the game goals for this context?
- What kind of media should be used to communicate intermediate and overall game goals?
- What kind of narratives provide an appropriate conceptual model to connect intermediate game goals into a meaningful gestalt?

2.4.4.13 Control

Control relates to being in control of an activity, but also being in command and having choices (Rigby & Ryan, 2012). Being 'out of control' is an emotive term and represents a significant response (Czikszentmihalyi, 1990). Control, in terms of interface design, is also discussed by Norman (2013), who suggests that flexible choice of actions is desirable; however, we should design interactions that constrain the user to avoid making mistakes, putting the interface ‘in control’ (Schneiderman, 2004; Norman, 2013). Jordan considers that products and interfaces should be designed to give users as much command as possible (Jordan, 2002). However, too much control over irrelevant processes or decisions would create a great deal of complexity and demand on our cognitive processes (Sweller, 1994; Norman, 2013). When it comes to a game, the player will feel that they are in control of play if they can get to where they wish to be or perform the desired in-game actions (Sweetser & Wyeth, 2005). Table 2-15 outlines Sweetser and Wyeth’s (2005) analysis of flow principles based on control, with their translation into design guidelines for games.

Table 2-15: Design guidelines, based on control concerns (Sweetser and Wyeth, 2005)

<table>
<thead>
<tr>
<th>Element</th>
<th>Proposed design guidelines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>Players should feel a sense of impact in the game world, as if their actions matter. Players should feel a sense of control over the game play.</td>
</tr>
</tbody>
</table>
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2.4.4.14 Discussion and implications for design research

As we saw in Chapter 2.2.5, Rigby and Ryan (2011) discuss the concept of autonomy, with control as a basic requirement, in terms of being a key emotional need. They also include elements of choice and a sense of purpose or volition, an innate human requirement. There are parallels here with the design guideline proposed by Sweetser and Wyeth (2005) above in that “players should feel a sense of impact in the game world, as if their actions matter” (Sweetser & Wyeth, 2005). Feelings of autonomy exist in games that allow an exploration of the game world and a choice of direction or action, such as adventure games. In Chapter 2.3.5.1, researchers claimed that a free and independent exploration of an environment was a motivational factor, along with the child being able to choose a particular direction (Wilde et al., 2003; Rogers et al., 2010). Children also seek independence at this stage, the choice of being able to creatively rearrange their environment was also noted (Lindholm, 1995) in Chapter 2.3.4.10.

These perspectives can help to expand the interpretation of control for the flow framework for games and children. How player control, autonomy, exploration, freedom of choice and a sense of volition influences the experience for PMBGs will be of interest in this research.

2.4.4.15 Proposed design guidelines

- Players should have a sense of volition towards the game goals and a feeling of impact in the game world, as if their actions matter.
- Players should be allowed choice over their actions within the game, where it does not create excessive levels of challenge.
- Players should feel in control over the game play.

2.4.4.16 Emerging areas for investigation

- How can factors of control (to optimize a flow state) for the game, i.e. allowing a sense of autonomy, volition and choice be balanced against the actual and perceived level of challenge presented.
- How can the child’s feeling of control through independence be allowed safely?
2.4.4.17 Feedback

Feedback for flow theory has a similar definition to the interaction principles, discussed in Chapter 2.4.3.9. Czikszentmihalyi (1990) claims that useful feedback provides information at the right time about what has been accomplished. The analogy of playing a guitar and not hearing any sound for some time helps to imagine this (Czikszentmihalyi, 1990).

The flow attributes of feedback for games are interpreted as design guidelines, in Table 2-16 (Sweetser and Wyeth, 2005).

<table>
<thead>
<tr>
<th>Flow property for games</th>
<th>Proposed design guidelines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feedback</td>
<td>Players should receive feedback on progress towards overruling goals. Players should receive immediate feedback on their actions for intermediate goals.</td>
</tr>
</tbody>
</table>

Hung, Chou and Ding's (2012) contribution directed at pervasive games has been interpreted into guidelines, provided in Table 2-17.

<table>
<thead>
<tr>
<th>Flow property for pervasive games</th>
<th>Proposed design guidelines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feedback</td>
<td>Reward incentive: players should be compensated for achievement and loyalty.</td>
</tr>
</tbody>
</table>

Feedback has also been considered in terms of rewards when related to generic LBGs, as shown in Table 2-18 (Ardito et al., 2010).
Table 2-18: Design guidelines: feedback and general LBGs (Ardito et al., 2010)

<table>
<thead>
<tr>
<th>Flow pervasive games</th>
<th>Proposed design guidelines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feedback</td>
<td>Give feedback to reassure players about the choices they have made through suitable rewards.</td>
</tr>
</tbody>
</table>

2.4.4.18 Discussion and implications for design research

Feedback was also discussed in section 2.4.3.5 as one of the fundamental interaction principles (Norman, 2002; Jordan, 2002; Shneiderman, 2004). Feedback was also perceived to be one of the key factors relating to experiences with games (McGonigal 2011; Murphy, 2013). This further supports the use of the flow model as it is considered a key pre-requisite. Previous discussions in section 2.4.3.5, led to the conclusion that immediate contextual feedback in the environment, GPS response for navigation, rewards and progress towards game goals were all significant forms of feedback to be considered during this research.

In Chapter 2.2.4.7, feedback was noted to be particularly vital in the process of addressing competence needs (Rigby and Ryan, 2011). However, the guideline presented by Ardito et al. (2010) shows feedback in relation to decisions and choices, thus it can be seen that feedback also supports autonomy needs. These factors suggest that feedback can be interpreted as part of the process of communication between the player and the game, which can influence other characteristics that contribute to flow. Therefore, the ideal form and nature of feedback for flow for PBMGs should be further investigated.

2.4.4.19 Proposed design guidelines: feedback

- Include feedback on progress towards overruling goals and intermediate game goals.
- Reward incentive: players should be compensated for achievement and loyalty.
- Include reward systems that provide positive and negative feedback.
- Give feedback to reassure players about the choices they have made.
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2.4.4.20 Emerging areas for investigation

- How can the game inform the player about what has been achieved and success through signifiers?
- What kind of rewards systems within the game are preferred to give positive feedback on progress?
- How can poor mapping and badly timed feedback about location through GPS be mitigated for?

2.4.4.21 Concentration and attention

Concentration is referred to as the ability to pay selective attention while ignoring other things according to Czikszentmihalyi (1990). Thus, ‘affords concentration’ is also interpreted as ‘holds our attention’ (Czikszentmihalyi, 1990). He further describes attention as “the distinct process [...] that selects relevant bits of information from the potential million bits that are available to our senses at any given moment”. It is also similar to Norman’s (2013) interaction principles. It has further been suggested that what we concentrate upon will be influenced by where we focus our attention (Takatalo, 2007). Sweetser and Wyeth (2005) translate the concentration and attention attributes of flow into guidelines for all games, as shown in Table 2-19.

Table 2-19: Design guidelines: concentration in games (Sweetser and Wyeth, 2005)

<table>
<thead>
<tr>
<th>Flow property for games</th>
<th>Proposed design guidelines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concentration</td>
<td>Games must provide stimuli worth attending to.</td>
</tr>
<tr>
<td></td>
<td>Games should quickly grab the players’ attention &amp; maintain it.</td>
</tr>
<tr>
<td></td>
<td>Players should not be burdened with tasks that do not feel important.</td>
</tr>
<tr>
<td></td>
<td>Games should have a high workload, but be within perceptual, cognitive and memory limits.</td>
</tr>
</tbody>
</table>
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Hung, Chou and Ding (2012) focus on pervasive games and asked specific questions; these were reinterpreted as guidelines, (see Table 2-20 below).

Table 2-20: Design guidelines: concentration for pervasive games (Hung, Chou and Ding, 2012)

<table>
<thead>
<tr>
<th>Flow property pervasive games</th>
<th>Proposed design guidelines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concentration</td>
<td>Pervasive games should support the player in the process of switching concentration between in-game tasks and surrounding factors of importance. Diverse stimuli: does the mobile game contain a range of audio and visual stimuli? Meaningful storyline: does the linear narrative encourage continued interaction?</td>
</tr>
</tbody>
</table>

2.4.4.22 Discussion and implications for design research

Concentration is critical to flow and will also depend on what we pay attention to, according to the theorists discussed in 2.4.3.1; we also have a limited ability to pay attention to multiple stimuli. Drawing attention to important elements is one of the key interaction principles discussed by Norman (2013). The similarity of this aspect of the flow model to interaction principles, that are important to guide this project also illustrates its significance.

Creating a balance of attention has been noted as a key issue for LBMGs with players often overly focussing on the screen and not on their surroundings (Schwabe & Goth, 2005; Frohberg et al., 2009; Eliasson et al., 2011; Molloy, 2016). In Chapter 2.3, it was noted that children pay attention to those aspects of a landscape that have certain affordances, both instructing and motivating them to engage with a particular element of it. Thus, it would appear that concentration and attention can also relate closely to the notion of feedforward. In a similar way to the concept of feedback, feedforward could be considered as part of the interaction and communication process through which the experience of play is executed. Therefore, during the design research phase, the influence of
feedforward and feedback on concentration is considered as these factors appear to be interrelated.

2.4.4.23 Proposed Design Guidelines

- Pervasive games should support the player in the process of switching concentration between in-game tasks and surrounding factors of importance.
- The game should use feedforward, visible signifiers and affordances to direct attention.
- Players should not be burdened with tasks that do not feel important.
- Games should have a high workload but be within perceptual, cognitive and memory limits.

2.4.4.24 Emerging areas for investigation

- What role does feedforward and affordance play in drawing attention?
- How can the activities, media and feedforward in the environment and the game create a balance of attention?
- Which media draw appropriate levels of attention?
- What kind of storyline is helpful to attention and concentration; does a narrative encourage continued interaction?

2.4.4.25 Flow for games: immersion

Being in a flow state is considered synonymous with being immersed in an activity (Chen, 2007). Although Ryan and Rigby (2006) consider immersion and concentration to be inseparable, others consider them to be different concepts (Ermi, 2005). According to Pine and Gillmore (1999) experiences can be categorised into two dimensions: participation and connection, which help to illustrate the concept of immersion. The dimension of participation varies from active to passive, and connection from absorption to immersion, best illustrated by different activities: entertainment (absorption and passive participation); educational (absorption and active participation); aesthetic (immersion and passive participation); and games (immersion and active participation). Absorption has much in common with concentration since it means directing attention to an experience whereas immersion means feeling a part of the
experience. However, as noted through the work of Norman, directing attention appropriately and concentration are related and concentration is also important to achieve flow, or immersion for a game. Thus, the concept of concentration can also be considered a facet of immersion. Different guidelines for immersion have been discussed (Sweetser & Wyeth, 2005), and are listed in Table 2.21.

Table 2-21: Design guidelines: immersion in all games (Sweetser and Wyeth, 2005)

<table>
<thead>
<tr>
<th>Element</th>
<th>Proposed design guidelines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immersion</td>
<td>The game should emotionally involve the player.</td>
</tr>
<tr>
<td></td>
<td>The game should engage at a visceral level.</td>
</tr>
</tbody>
</table>

Jegers' (2009) work focusses on how these issues relate more closely to mobile games, as shown in Table 2.22.

Table 2-22: Design guidelines: immersion in mobile games (Jegers, 2009)

<table>
<thead>
<tr>
<th>Flow pervasive games</th>
<th>Proposed design guidelines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immersion</td>
<td>Pervasive games should enable the player to shift focus between the virtual and the physical parts of the game world without losing too much of the feeling of immersion. Player actions should be avoided that might result in a violation of social norms in everyday contexts.</td>
</tr>
</tbody>
</table>

2.4.4.33 Discussion and implications for research

Mobile learning researchers have discussed immersion in terms of the visceral properties of the environment and feelings of being present within it (Wilde et al., 2003; Rogers et al., 2010). These feelings of being immersed within the natural environment may be what leads to the feelings of wellbeing and improvements in mental health, discussed in section 2.2.2.6.

A range of LBMGs have been cited, in chapter 2.2, with high levels of immersion, across real and virtual worlds, when including the use of a narrative or a roleplay
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approach, for example ‘Savannah’ (Benford, 2004), ‘Project: Riot 1831’ (Patel & Tuck, 2013) and in Ritchie’s (2014) work. For this research, the role of narrative will be important as this may be critical to maintaining overall immersion and overcome issues with balancing attention. A balance between being immersed in the game and the real world must be found to meet the objectives of the project, with the two worlds appropriately connected. Immersion and a flow state will be supported by meeting all of the previous pre-requisites through both the narrative and core mechanics, alongside the visceral properties of the environment, to be investigated through participatory design methods. For this study, the concept of concentration will be considered another aspect of immersion, as in the original model of flow.

2.4.4.34 Emerging research questions

- What role do narrative and game mechanics play to promote immersion in the game?
- What factors increase immersion in the real environment?

2.4.4.35 Proposed design guidelines

- Immersion
  - The game should emotionally involve the player.
  - The game should engage people at a visceral level

2.4.5 Conclusions for theoretical frameworks

Interaction principles were explored in relation to the playability of a PBMG and were also related to affective aspects and emotional needs, taking an ‘experience-based’ perspective. Interaction principles are useful to guide a design process and can be related to tangible features of a game design, through design guidelines. Participatory design research will be helpful to identify how such principles apply in practice to PBMGs and to identify new guidelines during the process.
Flow theory was considered to provide a model of an ‘optimal experience’ during game play. The aim to achieve a ‘flow state’ can be considered synonymous with creating immersion and therefore represents an ideal for the game design. The flow model was shown to encompass certain of the interaction design principles and, therefore, appears to provide a broad framework to structure design guidelines in the aim to achieve an optimal experience.

PBMG’s, however, present several issues that need to be overcome when attempting to design an ideal game experience. They include high levels of challenge to negotiate both terrain and the game interface and the natural environment provides a critical example. Ensuring that cognitive load is optimised by ensuring good usability for basic game operation and navigation will therefore be important and is investigated through design research. Appropriate levels of physical effort will also need to be identified.

An analysis of previous projects also identified problems when balancing attention across real and virtual worlds. Since attention is closely connected to concentration, a key component of Flow, the flow state could be threatened by divided demands on the player’s perceptual mechanisms. An aim of this project is to ensure appropriate levels of immersion in the physical, natural world and how this is to be achieved, while maintaining the flow during the game is part of the investigation during design research. Some researchers suggest that a narrative can draw together characters, places, activities and different demands on attention into a coherent whole, which may be important for maintaining flow. Since there is also a motivational component to attention, research will scrutinise key emotional needs addressed through the narrative design and the role played in achieving a balance of attention towards a flow state.

The flow models proposed by researchers do not include consideration of relationships with other players. Engaging with others during play is a potential further source of divided attention and could impact negatively on flow. However, as Csikszentmihalyi (2002) suggested, our social connections are vital to our experiences. There is also the consideration that being too much in the flow state
could impact on awareness of others, social engagement and cooperative play. These factors will be considered through observation during design research.

Communication of overall and intermediate goals, how they relate to each other through a consistent conceptual model, appropriate feedback mechanisms and how players can be instructed and motivated towards tasks through feedforward will also be considered during the design research process.
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2.4.6 Summary of emerging areas for investigation

Concentration & Attention
IT1. Which media types can draw appropriate levels of attention in the game?
IT2. How can feedforward in the real and virtual worlds create a balance of attention?

Feedforward
IT3. How can feedforward be used to motivate players towards increased engagement with the landscape?
IT4. How can feedforward help in communicating directions, and desired actions?

Consistency/Conceptual Models
IT5. How can the narrative provide meaningful connections in the mind of the player between the characters, activities and game goals?

Levels of Challenge
IT6. How can unnecessary challenges be overcome for PBMGs?
IT7. What are the key emotional needs of the audience for PBMGs and this context that need to be addressed to overcome challenges?
IT8. How can feedforward, affordance and signifiers help to reduce the challenge of playing PGMGs?

Clear Overall Goal and Intermediate Goals:
IT9. What kind of media should be used to communicate game goals (activities and overall game challenge)?
IT10. What kind of game goals can be understood by the player for this context?

Control
IT11. How can factors of ‘control’ be provided through game mechanisms i.e. allowing a sense of autonomy, volition or choice?
IT12. How can a child’s feeling of independence be allowed safely?

Feedback
IT13. How can the game inform the player about what has been achieved?
IT14. What kind of rewards systems are preferred to give positive and negative feedback on progress?
IT15. How can the game mitigate for poor GPS feedback about location?

Immersions
IT16. How can presence be maintained though focus is shifted across worlds?
IT17. Is a narrative helpful to create immersion for PBMG’s?
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2.4.7 Summary of proposed design guidelines

The following summarises the guidelines that have emerged in this chapter for further investigation. They are categorised according to interaction principles or flow.

**Attention/ Concentration**

**Balance of Attention**

**DT1.** The player’s attention should be balanced appropriately to allow awareness of the real world and focus switches included in the game plan.

**Reduce the Cognitive Effort for the Screen Based Activity**

**DT2.** Do not use animations or moving images if the application is meant to be in the background.

**DT3.** Reduce unnecessary features as much as possible.

**DT4.** Ensure that way finding activities do not require excessive attention and demand on the player’s cognitive load.

**Concentration and Attention**

**DT5.** Games must provide stimuli worth attending to.

**DT6.** Games should quickly grab the player’s attention & maintain it.

**DT7.** Players should not be burdened with tasks that don’t feel important.

**DT8.** Games should have a high workload but be within perceptual, cognitive and memory limits.

**DT9.** Diverse Stimuli: Include a range of audio and visual stimuli.

**DT10.** Meaningful Storyline: The linear narrative should encourage continued interaction.

**Feedforward:**

**DT11:** The game should use feedforward, visible signifiers and affordances in the virtual environment to instruct players and guide their activities.

**DT12:** The game should take account of visible signifiers and affordances in the physical world that impact on play.
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Consistency & Conceptual Models

DT13. Specific tasks should add up to an overall goal.

DT14. The game narrative can connect different content, activities or locations and help to create a meaningful whole (a conceptual model) in the mind of the player.

DT15. The game should be consistent with player's expectations, in its control, game play and adherence to the conceptual model formed.

Appropriate Level of Challenge:

DT16. The game should match the player’s skills during the activity to enable effortless involvement but also provide challenge.

DT17. Players should be motivated to overcome challenges inherent in PBMG’s by addressing key emotional needs.

DT18. Feedforward & affordance within the landscape can be used to instruct and motivate players to overcome challenge.

Clear Goals:

DT19. Overriding goals should be clear and presented early, including reference to key emotional needs, e.g. for competence: ‘save the world’; for autonomy: ‘explore the world’.

DT20. Intermediate goals should be clear and presented at appropriate times, including reference to key emotional needs, e.g. competence: ‘scale the obstacle’; autonomy: ‘choose which path to take’.

DT21. Include feedback on progress towards overriding goals and intermediate game goals

Control:

DT22. Players should have a sense of volition towards the game goals and a feeling of impact in the game world, like their actions matter.
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DT23. Players should be allowed choice over their actions within the game, where it does not create excessive levels of challenge.

DT24. Players should feel in control over the game play.

Feedback

DT25. Players should receive immediate feedback on their actions.

DT26. Players should receive both positive and negative feedback on their actions to indicate progress.

DT27. Reward incentive: players should be compensated for achievement and loyalty.

DT27. Give feedback to reassure players about the choices they have made.

Immersion

DT29. The game should emotionally involve the player.

DT30. The game should engage people at a visceral level.
2.2. Conclusions

2.5.1. Overview

After the literature review, considering the artefact, the context of play and theoretical principles to support the design, it was concluded that there are three approaches when working towards achieving an optimal experience:

1. Optimise the level of challenge, perceived or real, including the removal of any unnecessary effort that does not relate to the game play (further helped by interaction principles to improve usability and engagement).
2. Support the will of the player to overcome challenges (also helped by understanding how the game addresses key emotional needs).
3. Include techniques that can promote an awareness of place to increase immersion in the landscape during the game play.

Although many clues have been provided by the literature, practical design research is further required to further consider how the interaction, game goals, intermediate activities, core mechanics and narrative with associated media influence these key problems and the flow state. Other factors, such as whether the game should depend on a story (an adventure or roleplay genre) or follow a more ludic approach, the type of content it has and how it meets the child’s developmental stage should also be decided through co-designing with an audience.

Design research will, hence, use participatory design techniques to evaluate the proposed design guidelines discovered and arrive at new ones by considering the emerging areas for investigation.

2.5.2. Proposed pragmatic design guidelines

To investigate the experience of playing PBMGs, it is necessary to ensure that a baseline of pragmatic factors is addressed to ensure the game is safe and playable in a basic form. They are listed in Table 2-23 and relate to all PBMGs unless they are labelled as specific to the context of play.
### Table 2-23: Pragmatic factors influencing feasibility and safety

<table>
<thead>
<tr>
<th>Consideration</th>
<th>Pragmatic factor</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Design guidelines:</strong></td>
<td></td>
</tr>
<tr>
<td>GPS signal</td>
<td>DG1. The location should have sufficient GPS signal and sensitivity to maintain game play throughout.</td>
</tr>
<tr>
<td>Game function</td>
<td>DC5. The interface should replace a human guide and direct the player to locations as required.</td>
</tr>
<tr>
<td>(Contextual) Site location</td>
<td>DC1. The site should meet the NICE guidelines for access by children and families, that is:</td>
</tr>
<tr>
<td></td>
<td>• The site should be free of traffic and other known major safety issues, including cliffs, large bodies of water and so on.</td>
</tr>
<tr>
<td></td>
<td>• The site must be accessible through local transport or over a reasonable walking distance.</td>
</tr>
<tr>
<td>Game type</td>
<td>DG2. To create a game based on connecting with a landscape, a ‘search and find’ pattern should be followed, typified by a ‘treasure hunt’ style.</td>
</tr>
<tr>
<td></td>
<td>DG3. To direct players to specific points in a landscape, the game needs to be absolutely positioned.</td>
</tr>
<tr>
<td></td>
<td>DG4. To direct players to learn about specific locations in the landscape, the game should be site specific.</td>
</tr>
<tr>
<td>Accessibility</td>
<td>DG7. For a game to encourage play in an environment, it should be accessible, pervasive and always available to the player.</td>
</tr>
<tr>
<td>The following require further investigation to check how they should be implemented or in what form.</td>
<td></td>
</tr>
<tr>
<td>Ethics/Safety</td>
<td>DC2. Hazards within the environment should be mitigated for and players made aware of them.</td>
</tr>
<tr>
<td></td>
<td>DC25. Safe alternatives to face-to-face social interaction with strangers through the game should be considered.</td>
</tr>
<tr>
<td>Physical ability</td>
<td>DC10. Where the game will require walking or playing in a real environment, the player will need to maintain a certain threshold of physical ability, which they should be made aware of.</td>
</tr>
<tr>
<td>Cognitive ability</td>
<td>DC13. The game should not exceed a threshold level of cognitive ability for the developmental age of the player.</td>
</tr>
<tr>
<td>Time</td>
<td>DC7. The timing of activities and the game should be considered in relation to the abilities and information provided.</td>
</tr>
</tbody>
</table>
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The following guidelines relate specifically to the aim to connect people with a landscape where they are in light grey they have been superseded by a different guideline.

<table>
<thead>
<tr>
<th>Consideration</th>
<th>Guideline</th>
</tr>
</thead>
</table>
| Awareness of the landscape     | DC3. Activities should be included that promote physical interaction with the landscape and immersion through different senses.  
DT1. The player’s attention should be balanced appropriately to allow awareness of the real world and focus switches included in the game plan.  
This guideline also combined the following, and was, therefore, deemed extraneous:  
DG3. PBMGs that connect people with place should draw attention to features in the real-world environment.  
DT2. Do not use animations or moving images if the application is meant to be in the background.  
DT4. Ensure that wayfinding activities do not require excessive attention and demand on the player’s cognitive load. |
| Physical play outdoors         | DC11. Different physical play types should be included where considered safe by experienced nature guides. |
| Context specific:              | DC4. Methods to identify and increase awareness about species should be included to help develop a connection with natural phenomena. |

2.5.3. Flow prerequisites & PBMGs

The guidelines discussed in the following sections, have been taken from previous sections of the literature review and combined into categories related to the flow framework (Csikszentmihalyi, 2002).

2.5.3.1. Appropriate challenge: reduce unnecessary effort

A series of proposed design guidelines were identified that may help to design appropriate levels of challenge through reducing effort. Interaction principles can be studied that can reduce unnecessary cognitive challenge, minimise distractions or help to direct attention to locations or points of interaction. Feedforward (Norman, 2008), a notion which describes how possible actions are
conveyed to a player through affordances and associated signals provides a way to direct the attention of the player; the designer must understand how the properties of both the real world and screen-based interaction can inspire or draw the gaze to a specific location. Feedback also helps to indicate what has been achieved (Norman, 2002; Shneiderman, 2004; Nielsen, 2015). Levels of challenge must also be balanced against the abilities and developmental stages of the player, which influences the kinds of activities used, the duration of these activities and difficulty level of game play.

Table 2-25: Guidelines: appropriate levels of challenge

<table>
<thead>
<tr>
<th>Consideration</th>
<th>Guideline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical ability</td>
<td>DC12. Consider physical ability for the actions required, including anthropometric data about height, limb sizes, movement capabilities or strength of a given player. Further taking into account that: DC9. The game challenges should address the developmental stage of the player.</td>
</tr>
<tr>
<td>Cognitive load</td>
<td>DG6. Reduce unnecessary features and distracting media where possible. Also including: DT3. Reduce unnecessary features as much as possible. DC14. The volume and depth of information should be appropriate for the audience and context. DC15. Minimise the need to read on screen, to set the language to an appropriate level for all audiences and consider alternatives in the form of audio or video. DC13. The game should not exceed a threshold level of cognitive ability for the developmental age of the player. DT4. Ensure that wayfinding activities do not require excessive attention and demand on the player’s cognitive load.</td>
</tr>
<tr>
<td>Duration and stamina</td>
<td>DC7. The timing of activities and the game should be considered in relation to ability, preference and information provided.</td>
</tr>
<tr>
<td>Address different abilities</td>
<td>DC17. The game should include a range of activities that address different play types, abilities, preferences and emotional needs.</td>
</tr>
</tbody>
</table>
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<table>
<thead>
<tr>
<th>Consideration</th>
<th>Guideline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consider emotional needs</td>
<td>DT17/DG9. Players should be motivated to overcome challenges inherent in LBMGs by addressing their key emotional needs. DC17/DC22. The game should include a range of activities that address different play types, abilities, preferences and emotional needs to allow the player to demonstrate their skills.</td>
</tr>
<tr>
<td>Add meaning and affordance</td>
<td>DC16. Objects and places that have meaning and affordance for children are likely to be preferred and should be included.</td>
</tr>
<tr>
<td>Promote feelings of mastery</td>
<td>DG11/DC19: Allow the player to overcome challenges at an appropriate level of physical and cognitive development to feel a sense of mastery.</td>
</tr>
</tbody>
</table>
Chapter 2: Literature Review

<table>
<thead>
<tr>
<th>Consideration</th>
<th>Guideline</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC20. Gamifying the collection of information can promote feelings of competence.</td>
<td></td>
</tr>
<tr>
<td>DC18. Alternative methods to promote relatedness should be considered where interacting with humans is a safety consideration, such as nurturing play.</td>
<td></td>
</tr>
</tbody>
</table>

2.5.3.3. Clear overall and intermediate goals

For a flow state, the player must understand what is expected of them in terms of the overall game goal and the activities that contribute towards the overall goal. They must also feel that they are able to complete the goals. This can also relate to competency, autonomy and other emotional needs (Freeman, 2003; Rigby & Ryan, 2011).

Table 2-27: Guidelines: clear goals

<table>
<thead>
<tr>
<th>Consideration</th>
<th>Guideline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Setting goals, different media</td>
<td>DG11. Explain clearly through appropriate media how the player can overcome long term and intermediate challenges.</td>
</tr>
<tr>
<td>Setting goals through narrative: overall goals</td>
<td>DT19. Overriding goals should be presented early in the narrative, including reference to key emotional needs, e.g., for competence, ‘save the world’ and for autonomy, ‘explore the world’.</td>
</tr>
<tr>
<td>Setting goals through narrative: intermediate goals</td>
<td>DT20. Intermediate goals should be clear and presented at appropriate times, including reference to key emotional needs, e.g., for competence, ‘scale the obstacle’ and for autonomy, ‘choose which path to take’. DG10. A narrative should be included to set the scene for the game action and a premise to establish the overarching game goals; this may be in the form of a linear story or a more flexible narrative.</td>
</tr>
</tbody>
</table>

2.5.3.4. Control

According to Czikszentmihalyi (1990), an activity should allow the player to feel in control. This can be pragmatic, such as the game reacts to the interaction of the player, or emotional in that the player feels they have autonomy within the game. The PENS group also describe an emotional need for autonomy with similar
properties, such that it describes a feeling of having choice over decisions or having a sense of volition. For games, this can also be interpreted through having a choice of pathway or the ability to explore a game environment freely (Rigby & Ryan, 2011). This can manifest itself in specific ways for a given audience. For example, children have relatively little control over their lives compared to adults, and thus they may have a strong need to push boundaries, to escape into a fantasy world where they are in charge, to act independently and appear grown up. To address the flow prerequisite of control, the following were identified:

### Table 2-28 Guidelines: control

<table>
<thead>
<tr>
<th>Guideline</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DT24</td>
<td>Players should feel in control of the game play.</td>
</tr>
<tr>
<td>DC23</td>
<td>Players should be allowed to explore independently to promote feelings of autonomy.</td>
</tr>
<tr>
<td>DT22</td>
<td>Players should have a sense of purpose towards the game goals and feel a sense of impact in the game world, as if their actions matter.</td>
</tr>
<tr>
<td>DG14</td>
<td>Create a sense of volition in the player through key emotional needs.</td>
</tr>
<tr>
<td>DG13</td>
<td>Allow a sense of adventure through choice, the discovery of new situations &amp; characters.</td>
</tr>
<tr>
<td>DT23</td>
<td>Players should be allowed choice over their actions within the game where it does not create excessive levels of challenge.</td>
</tr>
<tr>
<td>DC24</td>
<td>Forms of imaginary play should be included to allow feelings of control in fantasy worlds.</td>
</tr>
<tr>
<td>DC25</td>
<td>Where roleplay or narrative are included, ensure themes are appropriate for age.</td>
</tr>
<tr>
<td>DC26</td>
<td>Include activities to promote creativity.</td>
</tr>
</tbody>
</table>

### 2.5.3.5. Concentration & attention

An ability to concentrate is central to a flow state and is sometimes considered synonymous with it. Concentration is also heavily influenced by what we pay attention to (Norman, 1969). The literature review has revealed that challenges to flow include divided attention between the physical and virtual worlds, with potential distractions coming from the media, issues with wayfinding and the level
of effort involved with the activity. Relevant guidelines, therefore, include:

**Table 2-29 Guidelines: concentration & attention**

<table>
<thead>
<tr>
<th>Guideline</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DT1.</td>
<td>The player’s attention should be balanced appropriately to allow an awareness of the real world and focus switches between worlds included in the game plan.</td>
</tr>
<tr>
<td>DT5.</td>
<td>Games must provide stimuli worth attending to.</td>
</tr>
<tr>
<td>DT6.</td>
<td>Games should quickly grab the player’s attention &amp; maintain it.</td>
</tr>
<tr>
<td>DT9.</td>
<td>Diverse stimuli: include a range of audio and visual stimuli where relevant to maintain interest.</td>
</tr>
<tr>
<td>DT7.</td>
<td>Players should not be burdened with tasks that do not feel important.</td>
</tr>
<tr>
<td>DT10.</td>
<td>Meaningful storyline: the linear narrative should encourage continued interaction.</td>
</tr>
</tbody>
</table>

**Table 2-30 Guidelines: feedback**

<table>
<thead>
<tr>
<th>Guideline</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DG12.</td>
<td>Provide immediate and clear feedback when players have achieved intermediate challenges and show how this relates to the overall challenges.</td>
</tr>
<tr>
<td>DT26.</td>
<td>Players should receive both positive and negative feedback on their actions to indicate their progress.</td>
</tr>
<tr>
<td>DT27.</td>
<td>Reward incentives: players should be compensated for achievement and loyalty.</td>
</tr>
<tr>
<td>DT28.</td>
<td>Give feedback to reassure players about the choices they have made.</td>
</tr>
</tbody>
</table>
2.5.3.7. **Immersion**

Immersion can be a result of flow prerequisites being achieved; however, there are some guidelines that do not fit directly into the other categories that promote it, including the requirement to have immersion across both domains, shown in Table 2-31

<table>
<thead>
<tr>
<th>Guideline</th>
<th>Instruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>DT18.</td>
<td>Include a meaningful narrative to encourage immersion.</td>
</tr>
<tr>
<td>DT19.</td>
<td>The game should emotionally involve the player.</td>
</tr>
<tr>
<td>DT20.</td>
<td>The game should engage players across virtual and physical worlds.</td>
</tr>
</tbody>
</table>

### 2.5.4. Aims for design research

However, further emerging areas for investigation also became apparent during the literature review that can be addressed through the design research where a more focused and empathic approach is possible to fully understand the latent and emotional needs involved. This also allows the refinement of existing guidelines and introduces further guidelines specific to this context of play.

### 2.5.5. Summary of areas for investigation

The following areas of concern emerged through the literature review for consideration during the design research phase. Similar issues have been combined as described:

- **IG** = Issues generated through the games’ literature.
- **IC** = Issues generated through the literature about the context of play.
- **IT** = Issues generated through the literature about theory.

<table>
<thead>
<tr>
<th>General pragmatic Issues to be resolved</th>
</tr>
</thead>
<tbody>
<tr>
<td>IC1. What are the best ways to safeguard children for PBMG play and promote feelings of safety for children and their parents?</td>
</tr>
</tbody>
</table>
Chapter 2: Literature Review

IG1. How can GPS reliability and other technical constraints impact on the experience of play for the natural environments under study?

IG2. How do the pragmatic dimensions of location, time and social interaction influence the experience?

IG3. What kind of duration should the game and activities be for this context?

Appropriate challenge

IT6. How can unnecessary challenges be overcome for PBMGs?

IT8. How can feedforward, affordance and signifiers help to reduce the challenge of playing PBMGs?

IC2. Which activities & play types that engage children with nature can transfer to an LBMG?

(IC7. is removed as the following are more detailed).

Physical ability

IC8. What level of physical challenge for activities within the game and duration of effort is acceptable?

Cognitive challenge

IC9. What level of cognitive challenge for activities is acceptable within PBMGs?

IG7. What kind of wayfinding tools, including maps, are appropriate for the audience, and what is their relationship with reality vs. fantasy?

IC10. Which media are appropriate to the child’s cognitive abilities in this environment?

IC11. What kind of identification tasks and information about nature are appropriate and relevant for this age group?

IC14. What are the test group children’s existing habits and feelings around the natural environment?

This context: motivation to overcome challenge

IT7. (Also represents IG8, IC12 as they were similar).

How can we predict and address the emotional needs of the player to support an optimal experience for this context and desire to overcome inherent challenges?

IG9. How can the game promote feelings of mastery and competence?

IG10. How can the game include aspects of autonomy, including adventure, exploration or choice?

IC3. Which aspects of the landscape are enticing and can encourage play through the notion of feedforward?
Chapter 2: Literature Review

IG5 + IC13. How can relatedness and a social component be included in the game without compromising safety?
IC5. Which outdoor activities and play types are preferred by children?
IC6. What kind of themes, do children of this age relate to?

Clear overall goal & intermediate goals

IT5. How can the narrative provide meaningful connections in the mind of the player between the characters, activities in the landscape and game goals?
IT9 (+IC10). What kind of media should be used to communicate intermediate and overall game goals?

Control

IC13. How can the child’s need for independence be allowed safely in the game for this environment?
IT11. How can factors of control (to optimise a flow state) be provided through game mechanisms, that is allowing a sense of autonomy, volition or choice?
IT12. How can the child’s feeling of independence be allowed safely?

Concentration & attention

IG6. How can attention be balanced to ensure awareness of the real environment at appropriate times?
IT1. Which media draw appropriate levels of attention?
IT2. How can feedforward in the landscape and game create a balance of attention?

Feedforward, affordances & signifiers

IT3. How can feedforward and meaningful affordances be used to motivate players towards an increased awareness of the environment?
IT4. What kind of role does affordance play in communicating directions and desired actions through signifiers?

IG4. How does the sequence of activities and number of events affect the experience?
IT16. How can presence be maintained in the game, particularly when focus shifts between worlds.
IT17. Is narrative helpful to create immersion for PBMGs?
3.1 Introduction

This chapter provides a rationale for the use of a ‘concept driven design research’ methodology to investigate the design of PBMGs and the optimisation of the experience of play. The aim in choosing the methodology was to follow a player-centred design process that would investigate players’ emotional and latent needs, alongside more pragmatic concerns that influence playability. Investigations that address complex design problems require a flexible and iterative design research methodology, with mixed methods that are participatory and inclusive to solve them (Buchanan, 1992; Sanders, 2002; Cross, 2007).

Here we examine the nature of ‘design research’, before explaining decisions about specific choices of methods, including the use of concept designs. A thorough investigation of all the facets of the design problem can be supported with the use of ‘experience maps’, whereby the factors that contribute to the experience are visually represented to prompt the researcher. Examples previously used by a range of other design researchers, will be discussed and a version for PBMGs subsequently developed to support this project. In addition, a range of methods will be selected that will consider the problem from different perspectives. Use of the ‘Say, Do, Make (Think)’ framework developed by Sanders et al. (2002) to support the choice of methods will also be discussed and applied to this case. Participatory methods within the methodology are indicated to solve a complex design problem that includes the player perspective (Buchanan, 1992). Communication between the designer and participant must be optimized and methods should be chosen that match the developmental stage of the participant. The selection and development of new co-designing methods to address the needs of children will also be discussed.

The material is dealt with in three sections, with objectives for each listed below:

Section 3.2. Design research methodologies

In considering HOW the research is to be carried out, the objectives are to:
Chapter 3: Developing the Methodology

- Consider the nature of design research, using comparisons with other methodologies, to address a ‘wicked design problem’.
- Define and defend a ‘concept driven design research’ methodology.
- Provide a rationale for using ‘experience based’ techniques and methods for accessing latent and emotional needs.
- Describe a participatory approach to including the player in the design process.
- Explain the method selection framework, ‘Say, Do, Make, Think’ to cross check data.

Section 3.3 Visualizing the experience

*In considering WHAT is being investigated, the objectives are to:*

- Define the dimensions of a context and player response.
- Evolve a map for ‘modelling an experience’ to direct design research for PBMG’s.

Section 3.4 Designing with and for children

*In considering WHO the methods should be adapted for, the objectives are to:*

- Describe the involvement of children in a participatory design process.
- Give an overview of existing methods used for Design Research with children and their relationship to the ‘Say, Do, Make’ framework.
- Propose adapted methods that will be appropriate for this situation and age group.

3.2 Design research methodologies

3.2.1 Design research as a ‘Third Way’

It can be argued that design research is distinct from research for other traditional academic fields. Bruce Archer has defined design research as “.... distinct from Science and the Humanities” and as a “third area of human knowledge” (Archer, 1979). Design Research allows a problem to be framed, research issues to be refined and guidelines compiled (Buchanan, 1992). According to Cross, design
Chapter 3: Developing the Methodology

research is concerned with developing design knowledge through intellectual reflection upon making and using artifacts. Cross explains that designers tackle ill-defined problems and their mode of thinking is both constructive and iterative (Cross, 2007). He also established some of the intrinsic qualities of what has become known as ‘design thinking’. Jonas also considers ‘research through design’ as the most valid design research paradigm (Jonas, 2007).

Archer (Archer, 1979) set out to investigate the difference between research generated during normal design practice and a valid research contribution. He laid out certain criteria that need to be fulfilled in order to justify calling the design activity “research”. It should be:

- systematic, because it should be pursued according to a plan of action;
- goal-directed, because the objects of the enquiry are posed by the task description;
- knowledge-directed, because the findings of the enquiry must go beyond providing mere information;
- communicable, because the findings must be intelligible to, and located within some framework of understanding for, an appropriate audience;
- representative of what is typical;
- reliably repeatable (for a given context);
- valid to give a true picture of reality.

3.2.2 Design research and wicked design problems

In the introduction to this thesis, the concept of "wicked problems in design thinking" was discussed (Buchanan, 1992), involving an initially large and diverse range of concerns, until aspects of the design can be tied down as requirements. Over time, the investigation becomes more focussed and research concerns are reduced accordingly. The application of this concept to phases of the current project is illustrated in Figure 3-1. The iterative nature of design research, referred to by Cross, is also implicit in the process of reviewing alternative options (Cross, 2007). This will be examined further in the following section.
Chapter 3: Developing the Methodology

3.2.2.1 An iterative process and theoretical outcomes

Iteration is fundamental to ‘design-based research’ (DBR), a specific case of design research, aimed at educational practices. It represents a systematic, but flexible methodology through iterative analysis, often based on collaboration with practitioners (Brown, 1992). Though it has many similarities with the methodology chosen, DBR is primarily focused on learning outcomes, rather than experiential ones. The Mor model, discussed in the introduction to this thesis, was adapted for this research, to represent the narrowing and focusing in on a reduced set of considerations. As shown in Figure 3-2; it is possible for designed artefacts (in this case concept prototypes), design knowledge (as design guidelines), research instruments (new methods and an experience map) and theoretical outputs to emerge, representing the contributions arrived at through this thesis. Eliasson, who conducted research on LBGs, transferred learning activities that were previously classroom-based to outdoor environments and provides an example of DBR and an iterative approach. New theoretical models were developed during the process, rather than just designed artefacts (Eliasson, 2013).
Chapter 3: Developing the Methodology

Figure 3-2 The Mor Model adapted to show research outcomes from this research

3.2.2.2 Concept Driven design research

For some design research, the creation of a well-designed artifact is a central focus and a significant outcome (Jonas, 2007); the knowledge that comes from it is often a reflection on its creation. However, Stolterman and Wiberg developed the ‘Concept Driven’ design approach for DBR (Stolterman & Wiberg, 2010). Here contributions to theory and knowledge are more significant than a singular design outcome. Components of the artifact are studied, to consider particular attributes, rather than perfecting the whole design. Concept Driven DBR was also interpreted by Eliasson (Eliasson, 2013). In the case of Eliasson’s work, research did not focus on the optimisation of a single outdoor lesson, but rather on separate explorations where attributes were evaluated. In a similar way, Reid et al. (Reid, 2011) investigated methods appropriate to considering the experiential properties of location-based games. They concluded that particular attributes should be isolated and explored with the player themselves, through a “bottom-up experimental approach”. Research field trials with small groups allowed close observation of the children’s response and were considered to be a particularly effective way to develop an understanding, exposing emergent behaviours for the game, which were not predicted. They also advocate a broader study to provide
Chapter 3: Developing the Methodology

a foundation for smaller studies, similar to the literature review carried out for this thesis.

3.2.2.3 Implications for design research
The concept driven and iterative approaches used in DBR practices will be adopted for this project. However, there are some differences in the methodology, because here there is an emphasis on emotional concerns and the player is placed at the centre of the investigation, rather than the learning goals promoted by the expert or educationalist. This reflects the project’s aim of focusing on the experience during the investigation.

3.2.3 Experience based design
An experience can include first impressions, through aspects of usability, cultural relevance and the memory of the complete relationship (Norman, 2005). The view of Norman and Jordan was discussed in chapter section 2.4, to demonstrate the interdependence of usability and emotional concerns in this respect (Jordan, 2002; Norman, 2005). Kelley, founder of the user-centred design consultancy IDEO, suggests that a key component of addressing a design problem involves awareness of feelings and emotions besides the practical elements of a problem to address the whole experience (IDEO, 2014); he was one of the founders of ‘design thinking’, considered to address complex design issues holistically. Experience design emerged as a community of practice, with associated methods, driven fundamentally by a people centred approach. Nathan Shedroff was also one of the early exponents (Shedroff, 2001) alongside Sanders (2002) and Forlizzi (2004).

Sanders et al. recognized a connection with methods in the social sciences that consider the role of emotions in human experience through questioning, observing and working with a target audience and reviewed their use in practice (Sanders, 2008).

3.2.3.1 Implications for design research
To investigate this design problem from an experience-based perspective, participatory methods that focus on the player will be required to enable an
empathic understanding of latent or emotional needs, alongside more practical and tacit needs. An iterative approach will be followed to evaluate findings from a previous phase, through concept prototypes and repeated participatory activities. Traditional social science methods required adaptation to the needs of designers, to enable ‘participatory design’ approaches, with children, discussed next.

### 3.2.4 Participatory design research and children

A general guiding principle for designers is that they should try to understand requirements that are appropriate to a particular audience, specified by the International Organisation for Standardisation, in ISO 9241-210:2010) (ISO, 2010). Such standards represented the need for user-centred design, where the design researcher studies the user through literature, questioning or observation methods that had evolved from social science. However, in 2008, Sanders and Stappers, after a broad review of design practice at the time, noted the transition from user-centred design to the practice of co-designing, where the user was an active participant in the design process (Sanders & Stappers, 2008; Sanders, 2013). They conclude that designers should, therefore, view the proposed audience for a design as the ‘experts’, when it comes to addressing their own requirements, and consider their perspective wherever possible, using methods that will provoke participation and clear communication.

When the user or audience are from a different demographic to the designer, including them in the design process is particularly necessary. One of the leading proponents of including children in the design process, Druin (Druin, 1999a) points out: “Children have their own likes, dislikes, curiosities and needs that are not the same as their parents or teachers.” Catalina Naranjo-Bock, a leading UX designer for children’s products, notes that: “one of the biggest challenges of designing interactive experiences for children is making them age-appropriate”. Children may have different levels of understanding, physical competency and communication skills, besides different behaviors (Naranjo-Bock, 2011).

Druin indicates that the significance of the child during the design process has increased over time and that evidence points to the ideal of including them as a
design partner (through co-design methods) as early as possible. Garzotto also demonstrates that children are highly capable of taking a creative role in designing (Garzotto, 2008). According to Obrist et al, in 2011 there was still a profound lack of knowledge of how to involve children, particularly during early conceptualisation and evaluation (Obrist, 2011).

However, the degree to which children can be included will depend on the project aims, access to children, ethical considerations and whether it is within their abilities. When designing technology there are limits to the role that children can play in the process, discussed next.

3.2.4.1 To what extent can we involve children?

Druin (Druin, 1999a) discusses four main roles that children are able to play in the process of developing technology varying in terms of level of involvement on the part of the child, namely User, Tester, Informant and Design Partner.

- As ‘Users,’ children contribute to the research and development process by using technology, while adults observe.

- As ‘Testers,’ children evaluate prototypes of new ideas that have not yet been manufactured or released. Children are again observed and asked for their comments and/or their interaction is recorded and evaluated.

- As ‘Informants,’ children participate at different stages of the design process, when they can inform progress. Both observational approaches and design input may be requested.

- As ‘Design Partners,’ children are considered equal stakeholders in the design of the new technology during the whole experience.

Scaife, Rogers et al. (1997; 1999); worked closely with children to develop a range of applications and concluded that, due to the complexities of technical projects and limits to children’s ability to conceptualise systems that do not currently exist, the role of ‘informant’ was most suitable.

3.2.4.2 Implications for design research

Evidence suggests that children can be effective and creative partners for co-
designing and should be included as early as possible in the design process (Druin, 1999a, Garzotto, 2008, Garzotto, 2011, Obrist, 2011). However, some of the activities for this project will involve complex ideas and a certain level of technical expertise, similar to the work of Scaife et al. (1997; 1999). In this project, the child is therefore to be an ‘informant’, according to Druin’s (1999) descriptions and the reasoning of Scaife et al. Specifically, game content and mini-prototypes are to be created by children. However, they are then interpreted (by the researcher) to create full concept prototypes, which are later tested for particular properties with children. However, selecting and then potentially adapting methods for use with children will be equally important and will be discussed next.

3.2.5 Choosing methods: Say, Do, Make (Think)

A possible framework for categorizing and identifying appropriate techniques is the ‘Say, Do, Make, (Think)’ (SDMT) framework created by Elizabeth Sanders, (Sanders, 2002). This was adapted from an earlier version created by Cain (Cain, 1998). Sanders describes it as ‘a framework to access human experience’ and it is based on fundamental definitions of human activity. Applied to design research, the framework represents gathering information from different frames of reference, helping to enrich data by viewing it from a range of perspectives.

Gaining access to player needs can be accommodated within the framework, using a three-part categorisation of needs into explicit, tacit and latent. ‘Explicit’ needs, are easily articulated, and easily identified, often of a practical nature. ‘Tacit’ needs are easily known requirements, which may nevertheless not be easily articulated by participants, such as how it feels to touch an object. Some of the deeper and less obvious, often emotional requirements can be described as ‘latent’ needs. They are not easily known or observed and yet are highly influential to the success of the design. In Figure 3-3, the three types of need (shown in the green triangle to the right) are related to example techniques for eliciting them (in the central triangle) and with the relevant aspect of the SDMT model (in the left triangle).
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Figure 3-3. The 'Say, Do, Make' framework related to methods and user needs

Say – These methods work with what people say about themselves. Typical methods are focus groups, interviews, and questionnaires. Say methods can have limitations, especially with children who not always able to fully articulate their needs, through language. They generally reveal the more explicit, more obvious needs.

Do – This describes observational techniques, which are usually an interpretation of ethnographic approaches and are sometimes referred to as design ethnography. Studying what people do allows one to see behaviours that the person may not be aware of or be able to articulate. These methods are, however, time consuming and sometimes the perspective of the child may be reinterpreted through the eyes of adults incorrectly. Tacit needs can generally be revealed during these processes.

Make – describes creative methods for working with participants. These are projective participatory techniques, which can predict requirements for a new scenario or design. They are usually more focused on expressing thoughts, feelings, dreams and the way participants think. Latent needs are more likely to be revealed using these methods, according to Sanders.

A list of typical methods associated with each category is provided in the Appendix 8.3.1. Some methods fall into an overlap between categories illustrated in the diagram Figure 3-4.
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Further evidence for the use of the SDMT framework can be found by considering the work of leading children’s researchers. Alison Druin et al. created a series of design research experiments with children and recommends collecting data from children in three different ways, in what is described as ‘cooperative inquiry’. This includes ‘adapted contextual inquiry’, from the original form introduced by Holzblatt (Holzblatt, 1993), where users are questioned and observed in a typical context (‘Say’ method). Technology immersion, is the second technique where users are observed in a room playing with existing technology or asked to achieve certain goals (‘Do’ method) and the third is creative participatory design, where the children make their own rough prototypes, while being observed (‘Make’ method) (Druin, 1999a, Druin, 1999b). Research with children, carried out by Verhaegh et al, to design mobile outdoor games for children aged 7-10, involved a similar triad of processes (Verhaegh 2006).

3.2.5.1 Data collection and triangulation

When applying qualitative methods, it is important to know when actions, opinions or ideas on the part of participants are significant and should form conclusions for the design. A report from the Centre for Socially Engaged Design (INSITU, 2016) helps to illustrate general principles across a range of case studies including the work of leading design researchers, including Blomberg and Rothstein (Blomberg, 1993) (Rothstein 2010). Their suggested procedure for validating data is as follows:

If an issue or idea has arisen on more than one occasion during investigations, this usually indicates that it is worthy of further exploration. If certain data is backed up by three different people or observed in three different ways it can be described as ‘triangulated’.
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When no new information is being obtained, it is time to move on and call that aspect of the research complete. The evidence gathered can then be tested in a subsequent phase in the form of design requirements by application to a design.

3.2.5.2 Implications for design research

To gather data from different perspectives appears to be particularly important for children, to ensure gaps in communication are overcome and a framework for choosing methods is valuable in this respect. Findings support the use of the general ‘Say, Do, Make, Think’ framework to choose methods for this project. Specific methods will require adaptation so that they are appropriate for children and this project, considered in section 3.4. The illustration in Figure 3-5 shows how the SDMT framework is applied to the first three stages of the research methodology.

![Figure 3-5 Addition of the Say, Do Make (Think) to the Research Process.](image)

Iteration, triangulation and the use of the SDMT framework support the aim to meet requirements for rigour in design research, proposed by Archer. Another way to ensure a thorough study involves the use of an experience map. This will be developed in the next section.
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3.3 Designing the experience map

3.3.1 Mapping the context

Investigating the context for a design has become increasingly important, particularly as digital applications become progressively more ‘contextually aware’ (Dourish, 2004; Reid, 2005; Zimmerman, 2007; Brown, 2010b). However, there are different definitions of context in the literature, for example: the Mobile Bristol Group associates context with ‘where’, thus specifically a location (Reid, 2005). Others define context more broadly as “the setting in which a situation occurs” according to Brown. In this case, it can also include many ‘dimensions’, including environment, social activity, goals/ tasks of groups and individuals and time” (Brown, 2010a). Zimmerman also proposed a multi-dimensional contextual model with fellow researchers (Zimmerman, 2007).

The five dimensions, proposed for context aware systems, shown in Figure 3-6, were:

- Location
- Individuality
- Activity
- Relations
- Time and Duration

Figure 3-6 Map of context for digital applications (Zimmerman et. al., 2007)
Another example is provided by the A x 4 framework, illustrated in Figure 3-7, developed by Rothstein et al. (2004); it includes Actors, Activities, Activities and Atmosphere and also provides more detailed components of these dimensions.

![Ax4 model by Rothstein et al. (2004), including properties of the dimensions.](image)

In a comparison of design research frameworks, shown in Table 3.1, we see similar fundamental dimensions of context, with different terminology, e.g. ‘people’ (actors, persons, users); ‘environment (atmosphere, space, situations, territory); ‘objects’ within environments (artefacts, stuff) and ‘activity’.

<table>
<thead>
<tr>
<th>Author</th>
<th>Use</th>
<th>Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Brown, 2010a)</td>
<td>Mobile Learning</td>
<td>Groups &amp; Individuals Goals/ tasks</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Environment Social Time</td>
</tr>
<tr>
<td>(Rothstein, 2004)</td>
<td>Design</td>
<td>Actors Artefacts Activities Atmosphere</td>
</tr>
<tr>
<td>(Wasson, 2000)</td>
<td></td>
<td>Users Objects Activities Environments Interactions</td>
</tr>
<tr>
<td>(Sachs, 2004)</td>
<td>Community Study</td>
<td>Persons Objects Activity Situations Time</td>
</tr>
<tr>
<td>(Zimmerman, 2007)</td>
<td>Design</td>
<td>Individual Activity Location Relations Time &amp; Duration</td>
</tr>
</tbody>
</table>

### 3.3.1.1 Discussion and implications for design research

Across these models, four primary pragmatic themes run consistently through their dimensions: ‘people’ (referred to as individuals, actors, users, persons or
groups), ‘environments’ (referred to as environment, atmosphere, situations or location), ‘activities’ (referred to as: activities or goals/tasks), for some, ‘objects’ (referred to as artefacts, objects, or not at all). For some, the component of time is included explicitly, for others it is implied in terms such as: ‘activities’. Similarly, ‘interactions’ between dimensions are referred to for some but are implied for others. It would seem that for maps where interaction is considered a fundamental requirement between all of the primary dimensions, it becomes unnecessary to state it explicitly, as is the case with this research. A ‘map’ of the other ‘pragmatic’ dimensions of the context for play would provide a useful prompt for this design research. However, for an ‘experience-based design’ project, the affective responses of the user/player are also important, emotional response is therefore discussed next.

3.3.2 Classifying emotional response

Ermi and Mayra suggest that a participant’s experience of a game is a response to the context (Ermi, 2005). Nardi is quoted to say: “people consciously and deliberately generate contexts in part through their own objectives; hence context is not just ‘out there’” (Nardi, 1995). Attempts have been made to classify the user’s response to the properties of objects, independently of a context. Jordan (Jordan, 2002) created a framework of types of pleasure interpreted from the work of anthropologist Lionel Tiger (Tiger, 1992): physio-pleasure, based on stimulation of our senses; ideo-pleasure, related our sense of identity or status; psycho-pleasure referring to our cognitive and behavioural response; and socio-pleasure includes our relationships with others. Donald Norman proposed three different layers of response to an experience in his book, ‘Emotional Design’ (Norman, 2005). Firstly the ‘visceral’ layer that describes our initial response, triggered by a sensory scan, immediate and often subconscious. Secondly, a ‘behavioral’ layer relating to a more considered working relationship with the object over time, relating to usability and tacit needs. Finally, the ‘reflective’ response, based on familiarity, often grown from memory and previous experience. The appeal of ‘Candy Crush’, a popular on-line game, for example, has immediate sensory appeal of the bright colours, relating to the ‘visceral’ layer; the game also has good interaction, relating to the ‘behavioural’ layer and finally, has been described as
having a ‘reflective’ response, reminding us of the youthful joy surrounding sweets. Norman’s categorizations of emotional response are quite temporal in that they relate to the stage of involvement with an interface.

### 3.3.2.1 Discussion and implications for design research

The categories of emotional response, offered by Norman, present a way of considering a user’s reactions to a design, without separating practical and affective qualities (Norman, 2005). Jordan’s framework has similar categorisations, with physio-pleasure being similar to the visceral layer discussed by Norman, psycho-pleasure similar to the behavioral layer and ideo-pleasure similar to the reflective layer. Jordan’s model also includes a social component, whereas this is implicit in Norman’s interpretation. How useful these models of emotional response are for this design research will be considered in light of ‘experience maps’ in the following section.

### 3.3.3 Context and the whole experience

Chen et al. discuss contextual elements such as location, time, and temperature, however they suggest that these should also be considered alongside the desires, commitments, and intentions of the human to form the motivational components of the context (Chen, 2004). Ermi and Mayra consider that motivational components, desires, and anticipations should be considered in light of previous experiences to actively construct the context (Ermi & Mayra, 2005). Other researchers, similarly, regard a contextual model as formed through a process of interaction over time, with personal, social and physical components. (Falk, 2000; Sharples, 2010). These perspectives include a temporal relationship with a design and reflect Norman’s model of emotional response, which could be considered in terms of length of association.

Lee Crossley and I (Grundy, 2002) developed the experience ‘map’ shown in Figure 3-8, during a research collaboration with a design practice, PDD Ltd. The model was evaluated through a range of live projects and found to be helpful for both prompting and communicating the data collected.
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Figure 3-8. Map of an experience (Grundy et. al 2002)

The map contains contextual dimensions but also includes layers that represent the user response, similar to those described by Norman, to define the experience over a period of engagement. The components relating to emotional response include:

- Sensing: How a design initially strikes us, perceptions, aesthetic properties. This shows similarity to Norman’s ‘visceral’ layer of experience.
- Understanding: How a design is interpreted during use, the usability of what is presented. This shows similarity to Norman’s ‘behavioral’ layer.
- Relating: How a design fits with existing preferences, based on previous experience or cultural influences. This shows similarity to Norman’s ‘reflective’ layer of experience.
- Feeling: how the experience leaves the user feeling. This has been added to Norman’s categories to represent a summation of all the other kinds of emotional response, after an experience. An overall, final impression.

This was compared with other models; Table 3.2 lists the dimensions of different models of experience with motivational and emotional elements.
Table 3.2: Contextual frameworks with emotional components in bold

<table>
<thead>
<tr>
<th>Name</th>
<th>SOUPA</th>
<th>Lonsdale</th>
<th>Crossley/Grundy</th>
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<tr>
<td></td>
<td>(Robson, 2011)</td>
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<tr>
<td>Use</td>
<td>Real World Research</td>
<td>Mobile App</td>
<td>Design</td>
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<td>Dimensions</td>
<td>Actors</td>
<td>Person Space</td>
<td>People</td>
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<td></td>
<td>Space</td>
<td>Space Agent</td>
<td>Settings</td>
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<td></td>
<td>Objects</td>
<td>Action Policy</td>
<td>Artefacts</td>
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<td></td>
<td>Activities</td>
<td>Policy Time</td>
<td>Technologies</td>
</tr>
<tr>
<td></td>
<td>Acts</td>
<td>Event Belief</td>
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<td></td>
<td>Events</td>
<td>Desire-Intention</td>
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<td></td>
<td>Time</td>
<td>(BDI)</td>
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<tr>
<td></td>
<td>Goals</td>
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<tr>
<td>Feelings</td>
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</tr>
</tbody>
</table>

3.3.3.1 Discussion and implications for design research

The Crossley-Grundy ‘experience map’ was applied to a range of live industrial projects and proved to be effective for a range of real design problems. The map also breaks down the layers of emotional response in more detail than the maps of other researchers, an attribute relevant to this project, and will therefore be used for this research. However, it will require adaptation to consider PBMGs and will combine useful attributes proposed by other researchers.

The Crossley-Grundy map places the user at the centre of the experience, which is appropriate when representing a user-centred approach. However, for games, the term ‘player’ is clearly more appropriate and will be used instead. The term ‘environment’, describes both the situation of play and atmospheric attributes, advocated by Rothstein et al (2004). The term is therefore preferable to the term ‘location’, which implies simply a reference to a place, used for the Zimmerman and Ax4 models. The term ‘objects’ can usefully describe physical artefacts discovered in a real-world environment, or alternatively virtual items. This would appear to be transferable, therefore, for a PBMG map. The Crossley-Grundy model lacks the prompting afforded by some of the other models about a social
dimension e.g. ‘actors’ in the Spradley-Robson model. The PENS model of emotional needs, developed by Rigby and Ryan also includes a ‘relational’ category, based on social factors (Rigby & Ryan, 2011). A relational component could be significant for an experience in a particular context and therefore this should be included in an ‘experience map’ to gather further information. The term ‘characters’ could be usefully used during design research, to indicate a relational component with both real players and in-game virtual characters. The final pragmatic contextual dimension is ‘Activities’. For a PBMG, the player interacts with objects, the game controls, but also the environment. Emotional responses, represented in the Crossley-Grundy ‘experience map' were simplified through the descriptions: ‘sensing, understanding and relating’. In the previous chapter a variety of researchers agreed that identifying key emotional needs can help towards game success for a given audience (Freeman, 2003; McGonigal, 2011; Rigby, 2011; Areliusarson, 2013; de Winter, 2015). Whereas the work of Norman and Jordan considers emotional response through the interaction of the player, identifying how key emotional needs can be addressed through the game can lead to pre-empting key features. The map is therefore adapted to include the key emotional needs, to provide a structure from which to consider the game experience and hence predict a flow state. A modified ‘experience map’, developed from these conclusions is described next.

3.3.4 PBMG Experience Map Dimensions

The final revised map of an experience for PMBG’s is shown in Figure 3-9.
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Figure 3-9. Adapted Crossley & Grundy map to include dimensions relevant to PBMGs

**Game Attributes:**

**Player:**
The player, their developmental stage of physical and cognitive ability, their culture, preferences and needs are placed at the centre of the investigation.

**Activities:**
This can represent tasks in the game representing intermediate, or overall game goals, but can be anything the player needs to do to engage with the game.

**Environment, Virtual, Real:**
The term ‘Environment’ is used to describe the location and its associated atmosphere. The latter could indicate information related to weather conditions or proximity to particular phenomena. The term is separated into physical, ‘real’ world and virtual components, because of the significance of this duality for PBMGs.

**Objects & Characters:**
The game will likely have physical or virtual objects, trees, virtual gold coins etc., in the case of games the player will also encounter other characters, which may be real or virtual.

**Player responses:**

**Physical:**
The tangible, physical reactions of the player to what is encountered; how it matches their physical ability.

**Visceral:**
The immediate response to the sensory qualities of the game, first impressions of what is encountered.

**Behavioural:**
How the game matches the cognitive ability of the player and meets aspects of playability, influencing levels of challenge for flow. Does the game ‘work’, how difficult is it to understand?

**Emotional Needs:**
How the game has met the key emotional needs of the player, which will be decided through a combination of the previous types of response to the game dimensions, providing a structure from which to pre-empt flow conditions.

The dotted arrows indicate the interactions between the different contextual dimensions. For flow, it is important to investigate the level of challenge they present, the degree of control the player feels over them and ability to concentrate on them, associated with flow theory.

Investigations for this study will therefore begin with the modified Crossley-Grundy model to help to conceptualise the context for a game design problem,
envision the associated experience and prompt effective design research. This, in turn, can help to investigate the parameters that contribute towards a state of ‘Flow’.

3.4 Methods for designing with children

In this section, we discuss how methods and techniques must be adapted in order to gain an empathic view and to investigate key emotional and latent needs. We also describe some initial work on the development and adaptation of techniques used later in the project. The aim of choosing appropriate methods is to “enter the child’s world and understand it from their perspective” (Kaplan, 2006). Mazzone et al. used participatory design methods to create a mobile music app with children. They suggest that the method chosen should consider the following questions (Mazzone, 2010):

a. Does the activity produce communicable results for design?

b. Can the designer make use of the ideas?

c. Does the method engage and involve children as active participants?

d. Is it suitable in terms of verbal and cognitive, social skills, knowledge and other abilities?

The methods chosen will also vary according to circumstances, according to Naranjo-Bock, as follows (Naranjo-Bock, 2011):

**Developmental Age & Experience**

The child’s developmental age should be considered when considering a method, especially their cognitive, verbal and fine motor skills. The child’s level of experience with digital devices will also influence their decisions and ability to engage with co-design techniques that involve technology.

**Location**

Inside a contained room, such as a classroom, researchers can observe a captive audience, with relatively constrained conditions. However, information in the field is also relevant for a location-based activity and observational methods should be tailored to suit.
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Adult/Child Relationship

The relationship of the child to the adults involved will be important and will vary depending on a particular context. For learning games, the teacher may take a dominant role in the direction of the project. However, for experienced-based design, the child’s opinion is more significant and methods should reduce the perceived authority of adults. Interviews with children should not be one to one for these reasons, but in pairs or with more children.

3.4.1 Creative methods for children

Creative activities have been considered useful as research methods for discovering latent needs, they can also address a child’s developmental age because they can rely less on language and memory (Naranjo-Bock, 2011). They are advocated by researchers from a range of disciplines (Druin, 1999a; Scaife, 1999; Kam, 2006; Sanders and Stappers, 2008; Walsh, 2009; Chipman, 2011). “Creative thinking in all fields occurs pre-verbally, before logic or linguistics comes into play, manifesting itself through emotions, intuitions, images and bodily feelings” (Root-Bernstein, 1999).

Creative techniques can also provide a communication bridge or an “ice-breaker” between the designer, researcher and the child (Walsh, 2009). This can positively influence the adult-child relationship described by Naranjo-Bock, since the child can have more freedom and the design outcomes can be more democratic. There is evidence that the discussions that emerge when working together on creative tasks can be important (Meech, 2014). The user group can be better understood during the process, rather than simply defining a design outcome. (Mor, 2010). Vaajakallio et al. noted that when people build design artefacts in groups together, there is an expression of thoughts and feelings that is, in itself, valuable (Vaajakallio, 2009).

3.4.1.1 Helping children to conceptualise a game

There are limits, however, for creative approaches to address a design problem; cognitive psychologists have shown that children find it difficult to conceptualize
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ideas that are abstract in nature and do not currently exist (Gelderblom, 2009). Activities that involve asking children to design a specific design outcome therefore may not be understandable; methods that simplify the task but provide relevant information have been considered a better alternative (Sanders, 2013). Sanders includes the use of ‘make’ tool kits, which are toy-like miscellaneous elements put together to allow easy creation of imaginary objects through enjoyable constructive activities, without dictating a final design. In Chapter 2.2, it was noted that activities that work well with children included drawing, collaging, making things, role play and using their imagination to create stories or enact scenes. Typically design research methods used with children have drawn on these play types, with examples seen through the work of Sanders, Vaajakallio, Walsh and Meech (Sanders, 2001; Vaajakallio, 2009; Walsh, 2009; Meech, 2014).

A method relevant to the production of games is ‘storyboarding’ also described by Naranjo-Bock as useful for working with children (Naranjo-Bock, 2012). Storytelling and storyboarding have both been used to enable both adults and children to communicate in an accessible form (Ryokai, 2012).

3.4.1.2 Implications for design research

Research has shown that the process of working with children during creative activities can reveal latent needs and improve communication between the design researcher and child. However, there is a limit to how far creative skills can be directed at technical design outcomes; this can be true of working with adults but is particularly notable due to the developmental age of the child. Simplified activities that provide relevant information are preferable and possibly more fun. Storytelling, represented through storyboarding can provide a familiar activity for both adult and child and support game development, therefore this is a useful method. However, though telling stories is natural to children, talking about themselves may be intimidating. An alternative approach to enable discovery of latent needs during this process was discovered during design research experiments, discussed next.
3.4.2 Development of a ‘Characters and Stories’ (CAS) method

Observations were conducted during a series of design research activities performed by final year undergraduate students, all of whom required the design of game characters for their project. An associated paper describes the rationale and process in more detail, featured in Appendix 8.2 (Grundy et al., 2012). The students conducted co-design experiments with a group of primary pupils to help create their characters. During the observations for each of the projects, it seemed that the children were revealing quite candidly their latent needs and fears and were talking about the character as though they identified with it. Frequently their preferences and, in some cases, personality were expressed through the designed character and their adventures. Similarities with the use of transitional objects was noted, defined and explained next.

3.4.2.1 Transitional objects

Young children can form intense attachments to teddy bears, dolls or even bits of cloth and this can be considered in light of ‘transitional object’ theories, whereby the object is considered to be another being, or character (Winnicott, 1953). A literature review by Litt (1986) suggests that they represent an essential phase of ego development leading to the establishment of a sense of self.

Studies have also considered the role of transitional objects for older children and considered them to be helpful in situations of emotional trauma (Roig et al., 1987). Psychologists, working with traumatized children sometimes use an inanimate object like a teddy bear or a doll to allow the child to communicate about upsetting events. I interviewed a counsellor, Liz Allsbrook, (2013) who uses this practice to communicate with older children and teenagers, through her work with Action in Rural Sussex (AIRS). She described how an inanimate character is used as a prop, to help where language may be limited and where the child is talking about events that are sensitive. An image of one of her props is shown in Figure 3-10. Characters were considered a potential conduit for emotion because can have personalities, behaviors, emotions, feelings, likes and dislikes just like their human equivalents.
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Characters drawn as transitional objects have also been used for art therapy (McCullough, 2009), suggesting that the process of drawing them is appropriate for children. There is also a connection with the creation of virtual characters. Researchers have considered the role of virtual game avatars, as transitional objects (Koles & Nagy, 2016): “By equipping their avatars with special skills, attributes and possessions, users were able to address and compensate for certain difficulties, shortcomings and anxieties deriving from their offline existence and family conflicts”.

3.4.2.2 Implications for design research

The use of characters as transitional objects has been considered a part of self-actualisation and can also provide comfort to a child (Winnicott, 1953; Litt, 1986). Characters have been used to communicate with older children, through three dimensional props or drawings and as virtual game characters (McCullough, 2009; Allsobrook, 2013; Koles & Nagy, 2016). There is also evidence that a character can form an alternative presence in the mind of the child and that the narrative surrounding them can support their emotional needs (Koles and Nagy, 2016). These findings suggest that creating characters and a narrative associated with them during the design research could access their latent needs in a more supportive way.
The efficacy of using characters and their stories as a process for this investigation required further examination and the theory was applied to a series of cases, which were more substantial projects of a digital nature, discussed next.

3.4.2.3 Evaluation of CAS methods.

Two pilot studies were carried out to investigate the potential benefits of the Characters and Stories (CAS) approach for understanding the latent needs of children against the criteria for methods with children, established by (Mazzone, 2010)

Firstly, the CAS method was used for a commercial project with the producers of online game 'Moshi Monsters', MindCandy, to provide ideas for a new game App, based on historical characters and their adventures. A detailed account of this study is given Appendix 8.3.2. In interviews, following the sessions, all five of the design team found the CAS method easier to explain than the game design task and found that the children could understand what was required of them more easily. The company members found the pre-emptive methods as a whole very informative about their audience, besides getting “great” ideas. The CAS activity proved not only more effective for designers, but also more enjoyable for the children.

The CAS method was also included in a 'Digital Citizenship' project (Gant, 2013) to support the co-design of a digital toolkit with young people that would empower their participation in neighbourhood development. Here, the paper-based CAS method was used with a class of 12 year-olds, to help them express their feelings about their local town. In subsequent discussions, members of the design research team noted that the children often drew characters that also reflected their own personality. Allowing the children to express their views through either sketched or animated characters proved to be an empathic approach to envisioning the future town for its residents and a useful preliminary stage to creating their own content.

The methods were evaluated against the criteria proposed by Mazzone, as follows:
Chapter 3: Developing the Methodology

a) Does the activity produce communicable results for design?
An understanding of the emotional needs for the design scenario were communicated effectively to inform the design process.
b) Can the designer make use of the ideas?
The child’s ideas can be utilised in creating game characters and narrative directly.
c) Does the method engage and involve children as active participants?
Questionnaires using Likert scales with children indicated that they had understood and enjoyed the CAS activity; verbal feedback from teachers and game designer also backed this up.
d) Is it suitable in terms of verbal and cognitive, social skills, knowledge and other abilities?
The CAS method avoids confronting children with the complexities of a design problem in a way that is more appropriate to their cognitive level.

3.4.2.4 Implications for design research
The pilot studies helped to confirm the benefits of the CAS method developed as an approach to working with children. However, as Naranjo-Bock (2012) suggests, other methods must be tailored to the desired outcomes, location and the required audience. To gain more information at the later stages of the project, co-design methods that allow children to create content for their own games and to implement a PBMG should be included, and these are discussed next.

3.4.3 Software co-design tools
Game engines or ‘platforms’ have been created that simplify the process of creating LBMG’s, via an interface that packages particular commands and removes the need for programming skills. A range of possible options were considered. more information is given in Appendix 8.3.6. For this project ARIS was chosen to co-create the children’s PBMGs.

3.4.3.1 ARIS
ARIS (Augmented Reality Interactive Storytelling Engine) is an open-source platform for creating and playing LBGs, tours and interactive stories (Field day, 2013). ARIS allows the addition of virtual characters and collectable items,
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besides the usual variety of media at key geographical points, allowing the creation of ‘adventure’ style games. The platform also has a feature for creating in-game dialogue and therefore has the potential to create story-based games, where players can interact with non-player characters. A screen shot showing how interaction points are displayed on a location map to change their position is shown in Figure 3.11. The child was able to add their media at desired locations in Stanmer Park using the interface.

![Figure 3.11 Using the map interface within the ARIS game engine.](image)

3.5 Conclusions for developing the methodology

In this chapter we have explored frameworks, models and methods for design research appropriate for design research with children. The following table summarises the implications for the methodology for this design research.
Chapter 3: Developing the Methodology

- A design research methodology is preferred to investigate a ‘real world wicked design problem’ with similarities to ‘design thinking’ approaches.

- Wicked design problems require the laying out of alternative solutions over time. The breadth of the subject matter studied is gradually reduced during the process as design attributes are ‘tamed’ and increased focus on key issues becomes possible.

- In common with DBR, this methodology will be iterative in nature with conclusions applied, tested and modified in each subsequent stage.

- A concept-driven design research methodology allows a ‘research through design’ approach that focusses on isolated properties through smaller concept prototypes, because theoretical outcomes and design guidelines are more significant than a singular designed artifact.

- This research will focus on optimising the experience, and hence involve emotional considerations besides pragmatic concerns. This requires participatory techniques that gain the player’s perspective.

- For each method, emergent behaviors or preferences are considered significant if findings are repeated and are subsequently further investigated.

- Information is cross-checked by choosing methods according to the SDMT framework to consider it from different perspectives and gain a deeper understanding of latent needs.

- An experience map can be used to ensure that different dimensions of the problem are included.

- Methods should be used that address the developmental age of an audience and address the guidelines presented by Naranjo-Bock.
4.1 Introduction

This chapter describes how the methodology was applied to this study, detailing the design research phases of the investigation. The literature review had already provided evidence from secondary research and data from large scale studies. Subsequently, design research focused on participatory involvement with smaller groups of children and nature experts, allowing a more direct, experiential approach to gaining understanding of the design problem. This is in line with the recommendations of previous researchers working with children (Druin, 1999, Reid, 2011). Methods for each phase were selected carefully for each procedure to match the requirements of the situation, in line with the Naranjo-Bock guidelines (Naranjo-Bock, 2012); for example, direct one to one interviews with children were ruled out on ethical grounds. Methods were chosen to gain different perspectives on relevant issues, using the Say, Do, Make/Think (SDMT) framework.

4.1.1 Aims

The aims of the chapter are to:

- Describe how the concept design research methodology was applied.
- Illustrate how the ‘Say, Do, Make/Think framework was used to select methods and triangulate qualitative findings.
- Detail each phase of investigation and the methods involved.
- Demonstrate how the ‘experience map’ helped envisage contextual dimensions and expand on research issues.
- Discuss the results of each phase

The sequence of activities follows, while the specific methods will be described within the relevant procedures.

4.1.2 Phases of Work

The following describes the general principles behind each phase of data collection. A more detailed description of procedures will be given in section 4.2 onwards.
Chapter 4: Design Research

Design Research Phase 1: Framing the problem.
This phase includes primary research to consider points arising from the literature, working prospective players and experts. The perspectives of the child and the expert were investigated through discussion, observation and participatory techniques.

Design Research Phase 2: Early Concepts
This phase began the process of working with groups of children and experts to co-design games and their content. The emphasis during this phase was on pragmatic dimensions. However, the process of revealing the emotional needs of the child was also started, through the CAS method. Research issues emerging in phase 1 were also investigated and design guidelines discovered through both literature and phase 1 research were also AB tested on children through basic concept game prototypes.

Design Research Phase 3: Design Details and Development
This phase continued the process of co-designing games and content, with an emphasis on considering more specific game attributes and latent needs. Research issues that had emerged in phase 2 were investigated and design guidelines that were produced were also AB tested on children through pre-developed game concepts.

Design Research Phase 4: Media and Wayfinding
This phase had a deeper focus on wayfinding and factors that influence attention and concentration across a virtual and physical space, found to be critical in maintaining a flow state for PBMG’s. A more finished prototype game was developed to test some of these specific game dimensions.

4.1.3 Applying an iterative process
A representation of how an iterative process was applied to the first two Design Research phases is illustrated in Figure 4-1. Phases 3 and 4 then repeat the same pattern.
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Figure 4-1 Illustration of the iterative process being applied to phase 1 and 2.

Each phase begins with design guidelines and research issues emerging from the previous one (starting with the literature review). Stakeholder perspectives are then studied through a range of methods, leading to a better understanding of the problem. This leads to the refinement and proposal of further design guidelines, along with the development of concept prototypes that are based on them. The concept prototypes are evaluated with children and new information gathered. This is repeated until the research questions are fully addressed.

4.1.4 Using the experience map

To prompt data collection, the experience model, developed in Chapter 3, was referred to, repeated in Figure 4-2.
Chapter 4: Design Research

It maps out different areas of the research problem and helps to expand on identified issues.

Table 4-1 below shows how the experience map was applied to expand on issues emerging from the literature; the original versions are in bold. Some of the issues do not require a definitive answer, e.g. IC14.5 on the children’s favourite outdoor activities, as the purpose is to find ‘acceptable’ solutions (in this case activities which are basically suitable for the game). Some issues apply throughout all design research phases, while others are specific to each procedure.

<table>
<thead>
<tr>
<th>Contextual Dimension</th>
<th>Experience Category</th>
<th>Issue</th>
</tr>
</thead>
<tbody>
<tr>
<td>IC 1 How can children be safeguarded during outdoor play and both parent and child to feel they are safe?</td>
<td>Player/Real Environment</td>
<td>Behavioural</td>
</tr>
<tr>
<td></td>
<td>Player/Real Environment</td>
<td>Reflective</td>
</tr>
<tr>
<td></td>
<td>Player/Real Environment/ Characters</td>
<td>Reflective</td>
</tr>
<tr>
<td>IC 14 What are the test group’s existing habits and feelings about nature?</td>
<td>Player/Real Environment</td>
<td>Reflective</td>
</tr>
<tr>
<td></td>
<td>Player/R Environment/ Activities</td>
<td>Behavioural</td>
</tr>
</tbody>
</table>
Chapter 4: Design Research

4.1.5 Applying Say, Do, Make, Think.

The following provides a brief example of how the SDMT framework was applied to influence choice of methods, illustrated in Figure 4.3.

![Diagram](image)

**Figure 4-3 Say Do Make (Think) applied to each phase.**

The following provides an example of how the model was applied to a question.

**IC 14 What are the test group’s existing habits and feelings about nature?**

**Say Research examples:**

- What do children say about nature and outdoor play?

  **Method:** A survey, to gather self-reported levels of enthusiasm for natural features, locations, animals, bugs etc.
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Do: Research examples:
- What do children prefer to do or play with in the natural environment?
  
  **Method:** Observations of children participating in Sussex Wildlife workshops.

Make: Research examples:
- If *making* the content for their ideal game, what kind of creatures and natural settings do they prefer?
  
  **Method:** Co-design activities, creating character designs chosen from natural features to communicate preferences.

4.2 Design phase 1: framing the problem

4.2.1 Overview

This phase was intended to frame the problem by understanding how children engage with nature and also how nature experts facilitate their experience from a primary research perspective. A procedure will be described for each activity in turn, carried out in the sequence described below.

4.2.2 Phase 1: sequence of activities

**Expert and children’s perspectives:**
- i) Experts: Semi-structured interviews with a range of nature organisations.

**Children and expert’s activities during ‘Holiday Clubs’:**
- iii) Field observations of SWT holiday clubs.
- iv) Questionnaires re. children’s experience during holiday clubs.
- v) Post activity semi-structured interviews with SWT Staff and volunteers.

‘Make’ activities with nature organisations:
- vi) Participation in SWT exhibition.
- vii) Designing outdoor games with teachers.

4.2.2.1 How the methods relate to SDMT

A matrix of how methods relate to SDMT framework is shown in Figure 4-4.
4.2.2.2 Issues and the experience map.

The following questions, in Table 4-2, were considered during this phase. They were expanded upon using the experience map.
### Table 4-2 Research Issues Phase 1

<table>
<thead>
<tr>
<th>Contextual Dimension</th>
<th>Experience Category</th>
<th>Issue</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IC 1</strong> How can children be safeguarded during outdoor play and both parent and child to feel they are safe?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Player/R Environment/</td>
<td>Behavioural</td>
<td>IC 1.1 How can children be safeguarded from real hazards by conveying information to the child?</td>
</tr>
<tr>
<td>Player/R Environment/</td>
<td>Reflective</td>
<td>IC 1.2 What are children afraid of and how can it be overcome?</td>
</tr>
<tr>
<td><strong>IC 3</strong> Which aspects of the landscape are enticing and can encourage play (through their affordance)?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Player/R&amp;V Environment/ Characters</td>
<td>Reflective</td>
<td>IC 3.1 What kind of natural creatures, e.g. animals, bugs etc. are preferred/acceptable as game content?</td>
</tr>
<tr>
<td><strong>IC5</strong> Which outdoor activities and play types (employed by experts) can engage older children with nature (and transfer to a PBMG)?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Player/Activities R. Environment</td>
<td>Reflective</td>
<td>IC5.1 Which of the expert activities are preferred/ by older children</td>
</tr>
<tr>
<td>Player/Activities R. Environment</td>
<td>Physical</td>
<td>IC5.2 Which games encourage functional play?</td>
</tr>
<tr>
<td>Player/Activities R. Environment</td>
<td>Visceral</td>
<td>IC5.3 Which activities can stimulate sensory play?</td>
</tr>
<tr>
<td>Player/Activities R. Environment</td>
<td>All</td>
<td>IC5.4 Which other types of play work in this environment?</td>
</tr>
<tr>
<td><strong>IC7</strong> How do the child’s physical and cognitive abilities match the demands of the environment and game context?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Chapter 4: Design Research

**IC9** What level of cognitive challenge for activities within PBMG’s is acceptable for older children and how long can they concentrate?

**IG 9** How do the pragmatic dimensions of Location, Time and Social Interaction, influence the experience?

**IC 11** What kind of identification tasks and information about the environment is appropriate and relevant for this age group?

**IC12** How can challenges be overcome by addressing the emotional needs of children for this environment?

<table>
<thead>
<tr>
<th>Player/activities</th>
<th>Emotional</th>
<th>IC12.1 How can the emotional needs of children be addressed through the activities in the environment?</th>
</tr>
</thead>
<tbody>
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<td></td>
</tr>
</tbody>
</table>

**IC 13** How can the child’s need for independence be allowed safely in the game for this environment?

**IC 14** What are the test group’s existing habits and feelings about nature?

<table>
<thead>
<tr>
<th>Player/ Real Environment</th>
<th>Reflective</th>
<th>IC14.1 What kind of predisposition do children have towards being in the natural environment? IC 14.2 Do they know what the benefits are?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Player/ Real Environment/ Activities</th>
<th>Behavioural</th>
<th>IC 14.3 How much time is spent in the countryside &amp; Why?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Player/ Activities</th>
<th>Reflective</th>
<th>IC14.4 What do children in this age range prefer to do with their time if not outdoors? IC14.5 What are their favourite outdoor activities?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

### 4.2.3 Procedure: phase 1i) expert perspectives

A series of five individual semi-structured interviews were carried out with employees from a range of organisations promoting nature activities, using the
Chapter 4: Design Research

The interview map shown in Appendix item 8.4.7. Semi-structured interviews allow the experts to dictate the course of the discussion when appropriate, with prompts to ensure the main points were covered. Four of the interviews were with SWT employees. Another was with ZJ, an employee at Wilderness Wood until 2013 and a leading member of the team co-designing for Project Wild Thing (Bond, 2012). The remaining two were with MR, managing director of the Circle of Life Rediscovery organisation (Robb, 2014) an organisation that leads Forest Schools for children and RO a forest school graduate and practitioner.

For SWT experts, a group discussion was also carried out with the managers of children’s activities. Participants were:

- NF, the Director of Operations for children in the Sussex area;
- KT, the Outreach coordinator and
- MM, member of the young person team at Woods Mill.

4.2.3.1 Objectives: 1i) expert views

The primary objectives of this procedure were to:

- Consider issues arising from the experience map.
- Obtain direct feedback from experts about the proposal to use PBMG’s and the suggestion that older children were a suitable age group to target.
- Gain the perspective of experts about general points arising from literature, such as the topical question of ‘nature deficit disorder’.
- Raise any other relevant issues that the experts wished to introduce.

4.2.4 Results: 1i) expert views

The interviewed experts did not have a problem with children using mobile devices to engage with the landscape, provided they were able to stop looking at the screen. The development of new bespoke forms of technology, however, was viewed as counterproductive environmentally. Adding physical interventions to the natural environment, e.g. labels or NFC was not considered appropriate, due to interference with nature and the practicalities of adding them to the environment, thus the use of existing mobile technology and GPS was preferred by all.
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Three of the staff had been involved with rehabilitation work with older children and teenagers and the benefits of outdoor play for mental and physical wellbeing were discussed at some length. They also felt that an awareness of the environment and preserving biodiversity was promoted through their interaction with the countryside and that this awareness should somehow be included.

SWT staff had observed that older children were less likely to participate in their holiday club sessions voluntarily. In 2012 and 2013, approximately 80% of those who attended were in the younger, 6-9 age group. This tendency was also confirmed by the private organisation and forest school. Comments made by ZJ included: “Some see it as less ‘cool’ than other pastimes like computer games or hanging around with friends”. “At this stage of development, they become conscious of fashion, including what clothing or footwear they have on, they do not wish to be associated with messy activities”. A key observation by three of the SWT staff was that once the older children were present and had spent some time in the environment, they were more likely to start to enjoy the activities.

4.2.5 Key findings: 1i) expert views

- Experts from SWT, Wilderness Wood and Circle of Life Forest school confirmed that they had noticed a reluctance for older children to take part in their outdoor workshops. A lack of connection with nature, discussed in the introduction to this thesis and the concept of ‘nature deficit disorder’ were also recognized.
- Experts also discussed the positive effects on wellbeing.
- The wilderness wood expert suggested nature has an ‘image problem’ with this age group and that a game production should include appropriate graphical styles and activities that suit older children.
- Expert feedback suggests that use of PBMG’s through existing mobile devices is an acceptable way to attempt to engage older children with a natural environment, provided head down interaction with the device is avoided.
Additions, such as props or extra devices embedded in the environment were not considered appropriate due to the impact they may have on the landscape.

Including facts about biodiversity would help the aims of the nature organisations concerned.

4.2.6 Procedure: phase 1 ii) survey for children

An online-survey was conducted through SurveyMonkey, and data was gathered from 65 children. Participants were recruited from St Andrews School, Hove, and Fairlight Primary in Brighton through the teaching staff and the survey was included as a class activity, so all children in a class of year 4 and year six pupils were asked to complete it. Children attending the Sussex Wildlife Trust holiday club were also asked to complete it at home. Sampling rationale is discussed in Chapter 3, the two schools are from opposite sides of the city and represent a range of different social backgrounds. Ages ranged between 8 and 11, within the target audience established. The group included some of the children who would be later participating in co-design activities. It also included children who did not regularly participate in outdoor play as a routine. A primary aim was to check if children in the research group had similar habits and preferences to those established within the literature. The questions were based on the NBN survey and developed through literature on typical outdoor games and discussion with SWT.

4.2.6.1 Objectives of the survey:

- Investigate the habit and opinion of local children to point out any contradictions with general national statistics about behavior gathered by NBN (Network) discussed in the literature review.
- Consider preferences around natural environments with older children, including the group who would participate in later design research.

4.2.6.2 Ethics

Parent and Child information forms were provided to indicate what was required and what would happen to the results, consent forms were provided to allow
permission to participate. Templates are provided in the Appendix, items 8.4.1 to 8.4.3.

4.2.7 Results: 1(ii) survey

A detailed analysis of replies to the individual questions in the survey is provided in Appendix 8.4.4, along with the initial ethics questions. Here we provide an overview of the results. In total, there were 65 respondents. The results were 42% male response and 58% female. The respondents were asked to do the survey by the teacher or group leader, it was not self-selecting, though they could opt out if required. 7% of the respondents described themselves as living in the countryside; 90% by the sea, 55% describe it as a city.

The survey indicated that 46% of this group visit the countryside twice a year or less, reflecting the consensus in the literature in Chapter 2.3 that a significant proportion of children do not frequently play in natural environments. These children understood some of the positive effects of nature and many indicated a preference for outdoor play rather than being indoors to play computer games, but this was generally conducted in local, accessible places, rather than a wild space. Often the preferred choices involved play with friends, suggesting that social interaction appeared a significant factor.

Most visits to the country were initiated by parents and involved an event, such as an organised walk or camping trip. Overall this would suggest that this group of children do not freely choose to play in natural environments on a regular basis, in common with the findings of wider surveys discussed in chapter 2.3.

Preferred activities outdoors included physical games. These are afforded by natural environments, according to Fjortoft (2004) and ‘treasure hunt’ style games, which have been noted as a good way to engage with landscape and experiential learning in the literature, chapter 2.3. The children also describe adventure games as their favourite game genre.
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Animals and birds were the most popular natural features, with rivers, beaches and general countryside being preferred environments. These children indicated a dislike for nettles and in some cases mud (others were very fond of it) but also a fear or dislike of insects, snakes, large animals and extreme weather, which provides some specific examples of the general perceived fear of nature discussed in the literature review, chapter 2.3.

4.2.8 Key findings: survey 1 ii)

- 48% of the group surveyed play in or visit natural environments twice a year or less, backing up national statistics and expert opinion about a lack of connection with natural environments, this was despite many being aware of there being benefits in attending.
- Parents and guardians played a large part in initiating visits and there was usually a related activity, such as a holiday or a walk.
- The children surveyed enjoy the social elements of play, whatever the basis for the game.
- Physical games and treasure hunts were preferred outdoor activities, with their favourite game genre being adventure games. These features could be combined in PBMG’s.
- Children are most fond of animals in nature, and indicated a dislike for insects, dangerous or large creatures, poor weather and getting lost. Stranger danger was not mentioned for this group, but possibly it was assumed they would be with parents due to the usual visit circumstances.
- Overall the findings reflected the results of wider surveys conducted by previous researchers and it can therefore be assumed that the local children and those that are likely to participate in the co-design activities have similar attitudes and behaviours to the general UK population of children.

4.2.9 Procedure: Children & expert activities-holiday clubs

Observations were carried out during the summer of 2012 and 2013, of typical holiday club activities organised by the SWT; this was followed by interviews with staff and questionnaires filled in by students. Recruitment of participants for each
event was done through SWT marketing, including their brochure and website, aimed at attendance by children between age 6 and 12.

1 iii) Field Observations: Eight separate holiday club events were attended, four at Stanmer Park, three at Woods Mill and one at Seven Sisters country park. A range of activities were observed through varied habitats to see if there was a notable difference in their form or acceptance. Notes were during each session; in some cases, photographs and video were recorded (where permission was given). For each event, there were between eight and ten children, aged between six and eleven.

1 iv) Questionnaires: Child’s view: after the events at Stanmer Park, ten questionnaires were handed to children and their parent/s. They were to establish how children had enjoyed the activities presented by SWT on the day.

1 v) Interviews: Experts’ view: Semi-structured interviews were carried out after two of the events at Stanmer Park, with key staff to get clarification about specific points that had arisen during the workshops and to get the benefit of their expertise for general concerns. Semi-structured interviews allow the participant to direct the course of the discussion or elaborate further as required, also to allow for any previously undiscovered important matters to be introduced. The concept map for the interviews is given in Appendix 8.4.7.

4.2.9.1 Objectives:
The objectives were to:
- Gain direct experience of the experts’ techniques.
- Observe the response and emergent behaviours of the older child
- Understand what would be required to replace an expert human guide in a game.

4.2.9.2 Rationale:
The holiday club events were chosen for the following reasons:
- The purpose of the SWT holiday clubs is to encourage interaction with natural environments and to raise awareness of biodiversity.
The clubs have evolved over a period of several years and have been adapted over that time to accommodate an understanding of a child’s preferences and level of cognition around natural themes.

They are potentially open to a range of children from diverse backgrounds for each event (including members and non-members of SWT) and include the age range under study.

Although only a proportion of the group were within target age, observations could be made about the difference in response across ages to the activity under study.

Each event is of a short duration (typically 4 to 5 hours) and they consist of a series of mini-activities that last between 15 minutes to 1 hour. The activity duration might be adaptable to the game environment.

4.2.9.3 Locations for observations

The club locations all fitted the previously identified NICE guidelines discussed in Chapter 2.3 and were sufficiently representative of indigenous species and a ‘wild space’.

Sites include Seven Sisters (coastal), Woodsmill (riverside and woodland) and Stanmer Park (representing woodland and open grassy spaces. The three locations are shown relative to Brighton, UK, where the children have been selected for later research activities in Figure 4-5. The latter was also chosen for
participatory design activity with children, due to its locality to their schools and appropriate nature); a more detailed terrain map is shown in Figure 4-6.

![Google map of area of Stanmer Park used in research](image)

**Figure 4-6 Google map of area of Stanmer Park used in research**

An example of a typical path followed is shown in Figure 4.-7; with a muddy surface. However, some areas had no path and were mildly undulating in general, but with occasional steep inclines or declines. Some routes may unfortunately be tricky for wheelchair users, so this would need to be clear or explicit provision made through wheelchair friendly paths.

![Typical muddy path](image)

**Figure 4-7 Typical muddy path**

### 4.2.9.4 Ethics

The observations for this activity were conducted at events routinely run by the SWT and normal ethics procedures were followed, such as signed permissions
from parents to engage in the activities in the chosen environment; this is a part of the normal process of booking the Holiday Club. Risk Assessments are also carried out by the Trust to ensure safety in the locations previously described. However, extra permission was requested from parents to allow children to fill out the questionnaires specific to this research and on two occasions to take photographs of the activity. Forms are shown in Appendix, item 8.4.6.

4.2.10 Results: SWT holiday clubs 1 iii), 1 iv) & 1 v)

The information gathered from the children’s questionnaires and the expert interviews served to support observations and hence the results are discussed together.

Observing the workshops enabled me to feel immersed in the experience personally and evidence emerged that did not relate to specific questions for this stage. For example, I became aware that it was quite rare to see animals in the wild. I also became aware of the difficulties that children had directing themselves and negotiating the natural terrain.

Towards answering the following questions:
IC 1 What are the best ways to safeguard children for PBMG play and promote feelings of safety for children and parents?
IC 13 How can the child's need for independence be allowed safely in the game for this environment? (in this case replacing the guide)?

The SWT guides were knowledgeable about the habitats presented, gave the children clear instructions, directed them to appropriate locations and appeared to motivate the group through their energy and enthusiasm. Before each event, the guide went through a health and safety checklist. The children were advised not to wander off far from the group, not to approach animals, including domestic dogs, not to eat things they had found, particularly fungi or berries that may look familiar, to be careful with certain types of terrain, avoid certain plants e.g. nettles or insects that sting, to watch out for eye level branches and not to climb trees or enter bodies of water unless supervised. The guide was also careful to state that children should not light fires on their own when introducing a supervised activity
to light a fire to cook marshmallows. Students were also asked to obey some protocols, not picking a whole plant out by its roots so that others could enjoy it (a rule of taking only 1/3 of a plant), respecting and not killing live creatures, dropping litter or damaging trees.

**IC 5 Which outdoor activities and play types can be employed to engage older children with nature (and transfer to a PBMG)?** The observed activities fell into different categories noted in the literature previously such as:

- Survival methods, for example: lighting fires, cooking, creating dens out of fallen branches and twigs (shown in Figure 4.8), or camouflaging themselves using mud or dyes from plants. (Deep, Physical Play)

![Figure 4-8 KT from SWT during a ‘den building’ activity](image)

- Finding objects, in a treasure hunt style, for example: by properties (colour, spiky, round etc.), or by category for plants, seeds and berries. (Exploratory, Sensory, Physical Play)

- Art/ build projects, for example: using the ink of berries as paint, sculptures from mud, collages with similarly coloured objects. (Constructive, Physical, Creative Play)

- Group games with rules, for example: hide n’ seek or role play around being an animal. Examples were ‘Bat and Mouse’ game, where children tag each other while blindfold in a circle and ‘Eagle Eye’ which is a form of themed hide and seek, shown in Figure 4.2.7-4 (Physical, Social Play).
Finding and Identifying activities, for example: pond dipping for creatures, bug hunts, trapping small rodents. (Exploratory, Sensory Play)

Detecting natural phenomena, for example: animal tracks, finding and dissecting owl pellets. (Exploratory, Sensory Play)

Sensory experiences, for example: being blindfolded and listening to bird song, or feeling different natural textures. (Sensory Play)

IC 5.1 Which of the expert activities are preferred by older children?

The children joined in every activity presented without exception, however, hesitation from the older children to participate in certain ‘Games with rules’ and ‘role-play’ activities was observed, where they were required to do an activity in front of others. They were also more reluctant about being blindfolded for the listening and feeling activity. The questionnaires later also backed up this finding, with the specified games being least popular overall. The children were very excitable during the capturing and freeing of small rodents and appeared to particularly enjoy lighting fires and cooking on them. Some children were competitive about the treasure hunts where named objects and objects with properties had to be found, trying to do it first; for example, when collecting coloured objects they would try to get the most objects. Art activities were attended to initially, but for two of the older children other distractions got in the way over time. Constructing things with practical outcomes, den building, the bee hotel and seed planter seemed to be easier to focus on in this environment but may be too time consuming for an LBGM.

IC 3 What kind of natural content, e.g. animals, insects etc. are liked/disliked?
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Observations, also backed up by the questionnaire, showed that rodents, during the capturing and freeing activity, were a popular subject. The ‘bug hunt’ was enthusiastically met by most except for two younger children who were afraid of picking up insects; however, they were happy to look at the specimens. Trees were enticing and flowers and plants followed behind, though most of the subjects were well received.

IC7 How do the child's physical and cognitive abilities match the demands of the environment and game context?
The children were able to negotiate the terrain between different points of interest, with varying levels of speed. They had to go carefully over certain areas and were guided away from climbing trees or any activity that might have been more hazardous. After journeying between points, the children were usually able to remain in an area should any of them have found it physically tiring.

IC9 What level of cognitive challenge for activities within PBMG's is acceptable for older children and how long can they concentrate?
The children would get distracted on occasion, especially the younger members; however the usual time per activity was between 15 to 40 minutes and this seemed to be acceptable for the group.

IC 11 What kind of identification tasks and information about the environment is appropriate and relevant for this age group?
Children were asked to find objects with particular colours or properties, and then the guide let them know what they had found, rather than suggesting they find particular species, e.g. ‘find holly’. This was perhaps to avoid embarrassing the children who didn’t know. However, most were able to identify some common birds, such as a robin and plants such as daisies or nettles.

Results iv) Children’s Questionnaires
Five questionnaires were returned for each session, so half the group in each case. This was due to them having to leave after the class, rather than a reluctance to participate. The children across age groups responded that they had enjoyed the day and most of the activities on offer. The older children had preference for the creature-based activities, including animal catching, pond dipping, bug hunting or treasure hunts specifically based on identifying things, followed by practical making activities and finally, creative artistic activities.
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Results 1 v) Post club interviews:
Although the clubs were intended for the full age range, SWT staff also confirmed that some activities were more acceptable to the younger children. In the interview with KT, she emphasised that although older children are more reluctant to participate in outdoor activities, in most cases they enjoy the experience once they are present and overcome fears about what they will have to encounter. Often, they are less interested in performing in front of others, e.g. when playing rule based games or sensory activities with others watching, which matched the observations.

4.2.10.1 Discussion: SWT Holiday Clubs 1) iii) iv) and v)

When investigating questions relating to how an PMBG can replace the human guide, including safeguarding children, the observations made it apparent that nature also needs to be protected. The game would therefore need to include the safety information provided but also the protocols for protecting the environment. Clear directions to sites and information about what is being observed at a location would also need to be replaced by the game, pointing to clear wayfinding instructions, and an engaging experience substituted for the motivation and encouragement offered by the human guide. The timings and durations of activities appeared to match the children’s abilities well. A maximum of 40 minutes was ideal for concentration and physical and mental effort and this should be noted for the PMBG; the stops to rest between walking to locations was also something that might be beneficial. Because the children moved around at different speeds and parts of the terrain were potentially hazardous, it was confirmed that a race type PMBG was not appropriate.

‘Functional play’ was encouraged by most of the activity types, but particularly by treasure hunts and games with rules; this type benefits the general health of children and is afforded by nature, according to Fjortoft (Fjortoft, 2004). ‘Deep play’ was represented by the survival themed activities. However, ‘fire making’ should, for safety reasons expressed by the guide, be excluded from any games that are independent of expert supervision. ‘Sensory play’ was represented by listening to birds, touching different textures, tasting natural foods and blindfolded
activity to exclude vision so children could use other senses and appeared to be effective in immersing the children in the environment. Of these activities only the listening to birds or touching textures are appropriate; blindfolding was neither popular with older children nor safe unsupervised. There was a notable lack of symbolic play, which is promoted by other organisations, so this will be further investigated. Games where the child is embarrassed socially were also notable and would be excluded. The varied play types can also be noted to relate to different emotional needs, for example ‘deep play’ is likely to help with independence and ‘control’ needs.

Considering content, although insects were deemed unpopular in the previous survey, this was anomalous with observations and feedback during the workshops and that children enjoyed being brave with insects. It also became clear throughout that animals were popular in both the survey and the workshops, however it was also noted from observations that the children are unlikely to view real wild animals on country field trips, without the kind of trapping activity carried out by the SWT. This suggested a possible area for investigating alternative representations of animals for the virtual environment in the game. The difficulties with wayfinding in this environment also led to investigation of this area.

4.2.11 Key findings: SWT holiday clubs 1 iii) iv) and v)

- Wayfinding is more difficult in a natural environment, particularly for children. The game needs to direct the child in the absence of the guide to appropriate locations and areas of interest and this will require careful consideration.
- The game needs to replace safety instructions for playing in natural environments, normally given by the human guide, but should also communicate necessary protocols to preserve the natural environment.
- The non-digital activities delivered by experts address a range of play types and help immerse children in the landscape. Examples could be included in the PBMG, as intermediate game goals.
Some activities are not safe without a guide; the criteria for including them in a PBMG should be further evaluated and some excluded from the game.

The timing of the activities (maximum 40 minutes) was suitable for both physical and mental effort of the older children and pauses between moving to locations helped to conserve energy.

Due to the difference in speed of navigating the terrain and the potential hazards observed it was confirmed that a race against time is not a good game design principle for these PBMG’s.

Including deep, functional, physical and constructive play types through the examples of activity noted, as intermediate game goals in the game could help meet competence needs in the player. Exploration and creative could help meet autonomy needs and should be further investigated.

Sensory play, alluded to in the results, was not originally included in the play types considered in the literature review (Frost, 1992) (Hughes, 2002). However, nature experts use such techniques to immerse the player in nature. Immersion is also a feature of flow and discussed by Ryan and Rigby (Rigby and Ryan, 2011).

Children enjoy animals, but they are rarely seen in the wild. Alternatives, such as including them in games virtually, should be considered.

Despite insects being cited as a major off-putting factor in natural play, the children appeared to be excited by their encounters.

Activities that embarrass or offend the older child in front of peers should be avoided, such as role play, changing their appearance or situations where they are likely to damage clothing.

4.2.12 Procedure: creative ‘make’ activities 1 vi) & vii)

The creative activities during this phase allowed close working with subjects and were to supplement the findings of the previous observations, to consider alternative activities with children.

vi) Constructive play during an exhibition.

Participation in a SWT stall at Stanmer Park, working with children and parents to make seedling pots and bee hotels using scrap materials. There were
approximately 20 families during my attendance. Discussions were held with the families during the activity and notes taken after the event.

**vi)** Expert workshop at a forest School.
I attended a workshop in September 2014 with the Circle of Life Rediscover team, a Forest School (Robb, 2014) based on developing activities to enable learning in natural environments. This involved participation in co-design processes with teachers delivering a range of subjects, focused on how nature can be used to support their work.

**4.2.13 Results: 1vi) and 1vii) creative make activities**

**vi) Constructive Play during an Exhibition.**
The activities for the SWT stall were appealing to younger children, but the older children were again less inclined to join in. The majority were families with younger children in attendance where parents encouraged them to participate. The build activities allowed facts to be imparted to the participants during the process, for example about the scarcity of bees or problems with using plastic for plant pots.

**vii) Expert Workshop at a Forest School.**
For the expert workshop at Circle of Life Forest School, the theme of collecting natural objects and treasure hunts as an activity came up again, in this case, we were finding things according to their properties, see Figure 4-9. This stimulated sensory play where properties such as ‘bendy’ or ‘bumpy’ objects are found, and used different senses, including touch, sight and, in some cases, smell.

Survival activities, including making rope from nettles and antiseptic from plants were also covered, however it was also noted that these were quite complex and difficult to understand, requiring quite specific techniques to create them and in some cases, even for adults, further input from the expert even after a clear demonstration. The findings helped to support answers to the questions:

**IC5 What kind of activities and play types are possible (to transfer to the game)?**
**IC 5.2 Which games encourage functional play?**
**IC 5.3 Which activities can stimulate sensory play (and immersion)?**
**IC 5.4 Which other types of play work in this environment?**
IC9 What level of cognitive challenge for activities within PBMG’s is acceptable for older children and how long can they concentrate?

An activity that evolved involved creating stories about nature to add a narrative to learning, was of interest and discussed for its great potential educationally among the teachers present, this indicated the significance of including a narrative and storyline for further investigation.

4.2.14 Key findings: 1 vi) & 1 vii) creative ‘make’ activities.

- The ‘deep play’ survival activities offered, during the circle of life workshop, such as making a rope from nettles would have been too complex without a guide to demonstrate them so were discounted from the game format as being above the threshold of cognitive ability.
- Sensory play could be encouraged by looking for particular properties in nature, such as ‘bendy’ or ‘spiky’, using touch, smell and sight.
- The build projects performed with the SWT were a potential way to communicate key facts about nature to the audience, such as the scarcity of bees and why we should make homes for them.
- Including a narrative or symbolic play in outdoor activities can appeal to the player’s imagination and improve immersion.
Summary of findings

This phase allowed conclusions from the literature review about the proposed use of PBMG’s and existing mobile devices to be validated. Investigations confirmed that older children are less likely to participate voluntarily in outdoor play in nature (findings for parts: 1 i, iii, v, & vi); experts consider that nature has an image problem with older, more self-conscious children (findings 1i), who were also seen to be less enthusiastic about potentially embarrassing situations in front of peers (findings iii). The decision to use PBMG’S was given positive feedback (findings 1i), provided sufficient attention was directed to the landscape. This issue was also raised in the literature review, chapter section 2.2 and therefore design research should consider the balance of attention in more detail and its relationship to concentration and Flow.

The PBMG will need to replace a human guide; from observations and interviews, information about safety (warnings about animals, strangers, poisonous plants, getting lost and physical hazards) should be included and protocols about nature (avoiding damage to the environment and flora). It was obvious that the children had some difficulty finding their way around. The game will also need to give directions to locations and clear instructions to the players. This indicates the need for investigation into wayfinding and how instructions can best be delivered.

In the literature review, the ‘search and find’ model was identified as a useful game pattern for learning on location (Lehman, 2012). A ‘treasure hunt’ game is an instance of this and was found to be interesting to this group of children (1ii) used by SWT during field observations (1 iii) interviews with experts (1 vi) and confirmed as interesting by the children, suggesting it is suitable for this application. A treasure hunt style game allows different play types to be included through a range of challenges.

The children enjoyed the activities presented, where they were challenged at an appropriate level (in line with Flow theory) either physically, mentally, through their knowledge or creative expression. Some proposed guidelines began to emerge
about timing of intermediate activities (maximum 40 minutes) but will need to be evaluated in the context of PBMGs.

The immersion levels observed in children confirmed that the game should be inspired by the activities created by experts, developed through considerable experience, to create engagement with the physical landscape. How this can be achieved should again be the subject of further investigation. It became clear that different activities are aimed at certain age groups and that some would not be straightforward if applied to a digital format. Others may not be considered safe without adult supervision or may encourage unnecessary risk, while others are just embarrassing or inappropriate for this group. Table 4-3 describes which activities were observed, considered as either suitable or unsuitable for use in following research phases.

<table>
<thead>
<tr>
<th>Type of Play</th>
<th>Suitable</th>
<th>Unsuitable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional Play</td>
<td>Activities that involve walking, hiding, lifting or touching objects.</td>
<td>Activities that encourage running on uneven terrain, jumping off high surfaces, climbing trees (potentially hazardous with no supervision).</td>
</tr>
<tr>
<td>Deep Play</td>
<td>Den building, camouflage, creating hides.</td>
<td>Fire lighting (potentially dangerous) foraging for food (may confuse edible/poisonous).</td>
</tr>
<tr>
<td>Constructive/</td>
<td>Build animal homes or shelters, e.g. bee hotel, making art work or sculptures from nature, tree rubbings.</td>
<td>Nettle ropes (cognitive effort too high).</td>
</tr>
<tr>
<td>Creative</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exploratory Play</td>
<td>Collecting objects of certain colour or form, finding different species, for example during ‘bug hunts’.</td>
<td>Collecting species that are difficult to find or recognize (level of understanding to be confirmed).</td>
</tr>
<tr>
<td>(Treasure Hunts)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abstract (Symbolic)</td>
<td>Using objects as part of a narrative. Telling stories about nature.</td>
<td>Role play games or games with rules (due to embarrassment).</td>
</tr>
<tr>
<td>Play</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensory Play</td>
<td>Listening to bird song, natural textures.</td>
<td>Blindfolding activities or where senses are restricted (making players too vulnerable &amp; unsafe).</td>
</tr>
</tbody>
</table>
Many different play types were exhibited during the workshops (1 iii), meeting the older child’s preference to show their ability in preferred areas and therefore address competence needs; they are also able to express themselves through creative techniques, addressing autonomy needs. Exploration is also possible with a treasure hunt activity, meeting emotional needs for autonomy. Sensory play can also be included, to promote immersion and a narrative could also theoretically promote a balance of concentration and immersion across virtual and physical worlds, requiring further investigation with children. When a narrative is included, this becomes an adventure style game, which could add the fantasy element that also helps with issues related to control in flow theory.

In terms of game subjects, animals were engaging for young people, yet it was rare to see any. This gave the idea that perhaps the game could allow the player to view creatures virtually, though they were not physically present. Preferred natural subjects will also be further investigated during subsequent design phases 2 and 3. As nature has been described as having an ‘image problem’, by experts, the child’s preferences for the appearance of characters and the look and feel of the game are important.

4.2.16 Implications for Design Research.

A treasure hunt style game will be adopted when co-designing PBMG games in subsequent phases, including various play types to address different areas of skill or knowledge and associated emotional needs. Activities that appear suitable will be further evaluated through concept prototypes in phase 2, for safety and engagement. The game content, including activities, preferred natural subjects for characters and the game look and feel will also be considered through participatory methods with children. Other implications will be considered under the relevant categories for achieving a flow state, discussed next.
4.2.17 Conclusions for a flow state

4.2.17.1 Levels of Challenge:
The activities presented were within an appropriate level of physical challenge for older children (and therefore most people), but some may be too cognitively demanding within a game environment.

- Appropriate physical and cognitive challenge for activities in the game should be investigated during Phase 2 and 3.

4.2.17.2 Clear goals and intermediate goals:
The children were clear on how to do each activity and the tasks within them, due to the clear instructions of the guide. This information, along with the constraints around activities, including health and safety and nature protocols should be clearly presented within the game,

- How safety information and protocols can be introduced requires further evaluation during phase 2.

4.2.17.3 Control:
Activities that represent ‘deep play’ under the ‘survival’ category can address emotional needs for independence and autonomy. Free exploration during treasure hunt activities also allows choice of direction and objects to be found. Creative play allows self-expression. The children were able to show off different abilities promoting emotional needs for competence, through the challenges. These emotional needs appear to relate to a need for control.

- The translation of these emotional needs and factors relating to control to a game environment will be evaluated through phases 2 and 3.

4.2.17.4 Concentration:
The children’s attention was guided by the expert to an area or activity, however once actively participating in a task they seemed engaged. The activities appeared to encourage concentration on the landscape or elements or nature, as that was their purpose.

- How the child’s attention is directed without human intervention needs further consideration.
• Wayfinding, which presents a particular challenge to concentration within the game, will also need to be addressed.

4.2.17.5 Immersion:

The properties of the PBMG and how they meet the pre-requisites already discussed will be a predictor for an immersive flow state. How these apply will be a part of further investigation. The activities observed also encouraged different types of engagement in the natural world, including physical and visceral immersion. The use of narrative was also noted as potentially increasing immersion. Sensory play activities helped to increase visceral immersion.
4.2.18 Proposed guidelines.

- Information about protocols in the natural environment should be included, alongside how to keep the player safe.
- Traditional play activities, adapted for an LBMG, should be safe and understandable without adult supervision.
- Functional play should be included to stimulate activity and support health.
- Symbolic play should be included to stimulate imagination and create new perspectives on nature.
- Sensory play should be included to aid immersion.
- Exploratory play should be included to promote autonomy and independent engagement with the landscape.
- Constructive Play can be included to enable learning about nature in an enjoyable way.
- Include activities that allow the child to express their creativity, knowledge and skills.
- Avoid activities that cause potential embarrassment in front of others, including role play or games with rules.
- Time constraints should not be included but activities aimed at a maximum 40 minutes to match physical and cognitive levels of effort.

The following are confirmed and assumed for further design research:

- A ‘treasure hunt’ style game allows a range of play types, and appropriate levels of challenge.
- Traditional play activities, associated with non-digital play, involving interaction with the physical world, should be included as intermediate goals in an PBMG to create engagement with the landscape.
- Opportunities for rest should be factored into the game, therefore a race against time is not suitable.

4.2.19 Further emerging issues

- What kind of characters and narratives are appropriate to the game?
4.3 Design phase 2: early game concepts

4.3.1 Overview

This phase involved primary research and working alongside children and nature experts to gain their perspective on the design of PBMG’s. The role of the child was as an ‘informant’, according to the classifications of previous researchers (Scaife, 1997; Druin, 1999), because possible game content and narratives were co-designed with children and then subsequently interpreted to create a more finished resulting game. Children also contributed as a ‘tester’ when playing games created to evaluate previously established guidelines.

During this phase, pragmatic usability needs were considered, such as timing, duration and the need for children to understand the basic game principles. Issues relating to navigation and attention were previously noted. The study therefore investigated these aspects in relation to media on screen, but also how the preferences of the child for particular natural phenomena could be an influence on directing attention to the environment and finding key landmarks. The process of understanding latent and emotional needs for PBMG’s, using the Character and Stories method (CAS), was also initiated.

The final activity during this phase was the children creating their own PBMG’s via a series of participatory activities. Activities were carried out with pupils of both Fairlight Primary School, Brighton and St Andrews School Primary School, Hove, to represent different types of area and social background.

The general aims of this phase were to:

- Test assumptions and guidelines emerging during previous phases through prototype concept games.
- Gather data about pragmatic dimensions of the game during participatory sessions, to enable a threshold of playability to be identified.
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- Co-create with the children to understand more about their preferences and emotional needs for PBMGs and natural environments, using the CAS method.
- Consider factors that influence navigation around a natural space.

4.3.2 Phase 2: sequence of activities

The following describes the sequence of activities:

Preferred subjects/stories

2 i) A Character and Story activity (CAS) using nature as a theme.

Co-designing a basic game.

2 ii) Photography in natural environments.
2 iii) CAS activity for their game.
2 iv) Playing prototype games prepared for them.
2 v) Creating game content using MORFO.
2 vi) Creating games in ARIS.
2 vii) Playing their own games.

4.3.2.1 Phase 2: ‘Say Do Make’

The relationship of these methods to the SDMT model is shown in Figure 4-11.

![Figure 4-11 Say Do Make for Phase 2](image-url)
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4.3.3 Research issues and experience map

The issues detailed in Table 4-4 are addressed in this section. The full list of issues for all phases is in the Appendix, item 8.5.11. Issues have been expanded to focus on more detailed investigations, using the Experience Map.

<table>
<thead>
<tr>
<th>Table 4-4 Issues during Phase 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contextual Dimension</td>
</tr>
<tr>
<td>-----------------------</td>
</tr>
<tr>
<td>General and Pragmatic Concerns</td>
</tr>
<tr>
<td>IC 1</td>
</tr>
<tr>
<td>Player/ R. Environment</td>
</tr>
<tr>
<td>Player/R Environment/</td>
</tr>
<tr>
<td>Player/R Environment/</td>
</tr>
<tr>
<td>IC2</td>
</tr>
<tr>
<td>R. Environment/ V. Environment/Activities</td>
</tr>
<tr>
<td>R. Environment/ V. Environment/Activities</td>
</tr>
<tr>
<td>IR1</td>
</tr>
<tr>
<td>Player V. Environment/ Characters</td>
</tr>
<tr>
<td>Player/ V. Environment/ Activities</td>
</tr>
</tbody>
</table>
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**IG2. How do the pragmatic dimensions of Location and Time influence the experience?**

*Further separated into:*

<table>
<thead>
<tr>
<th>Player/ R. Environment/V. Environment</th>
<th>Behavioural</th>
</tr>
</thead>
<tbody>
<tr>
<td>IG2.1. How do distances in a particular location affect the experience of play?</td>
<td></td>
</tr>
<tr>
<td>IG2.2. What kind of duration should the game and activities be, for this context?</td>
<td></td>
</tr>
<tr>
<td>IG2.3 Are the observed time constraints in phase 1, for activities appropriate for a PBMG?</td>
<td></td>
</tr>
</tbody>
</table>

**Clear Goals**

**IT9 What kind of media should be used to communicate intermediate and overall game goals?** (IR1.1 How can the activity instructions best be described through the game media?)

**IT10. How should the overall game goals relate to intermediate game goals to improve understanding (and volition)?**

**Levels of Challenge: To reduce unnecessary challenge.**

**IC 9 What level of physical & cognitive challenge is acceptable for tasks in the game?**

**Control: Emotional Needs to overcome challenge.**

**IT7. (and IG8) How can we predict and address the emotional needs of the player to support an optimal experience for this context?**

**IT7.1: How can challenges promote feelings of competence and mastery?**

**IT7.2. How can a social dimension be safely added to an LBMG?**

**IT11. How can feelings of ‘control’ be promoted through the game, through allowing a sense of autonomy, volition and choice.**

**IC13. How can the child’s need for independence be allowed safely through the game?**

**Concentration & Balance of Attention. (n.b. some questions also influence levels of physical and cognitive effort)**

**IT2. How can feedforward in the landscape and game create a balance of attention?** (includes: IT8. How can feedforward, affordance and signifiers help to reduce unnecessary challenge when playing PBMG’s?) (Also includes aspects of wayfinding, found to be critical).
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<table>
<thead>
<tr>
<th>R. Environment/Activities</th>
<th>Visceral</th>
<th>IT2.1 Which features of the landscape draw the player’s attention (have more visibility)?</th>
</tr>
</thead>
<tbody>
<tr>
<td>R. Environment/Activities</td>
<td>Reflective</td>
<td>IT2.2 Which features of the landscape are meaningful to the child raising awareness of it (&amp; have added affordance)?</td>
</tr>
</tbody>
</table>

**IT4. How can feedforward/affordance through the virtual game help in communicating directions?**

**IT1 Which media types draw appropriate levels of attention to the screen?**

**IG1. How can GPS reliability and other technical constraints impact on the experience of play for the natural environments under study?**

**IG7. What kind of wayfinding tools, including maps are appropriate for the audience?**

<table>
<thead>
<tr>
<th>R. Environment/ V. Environment/ Activities</th>
<th>Behavioural/Visceral</th>
<th>IG7.1 What kind of map is preferred?</th>
</tr>
</thead>
</table>

**Feedback**

**IT15. Can the game mitigate for poor feedback through GPS?**

**Immersion**

**IG4. How does the sequence of activities and number of events affect the experience?**

### 4.3.4 Procedure: Characters and Story method (CAS)

In September 2012, ‘Make’ sessions were undertaken using the ‘CAS’ method, described in Chapter 3. This activity facilitated discussions to provide more primary research data. Two workshops were conducted, with pupils from St Andrews School in Hove, there was a group of 27 and 26 pupils respectively, aged between 8 and 9. To compare the data emerging, one group were asked to draw characters and stories based on their favourite natural subjects (non-game group), the other were asked to draw stories to be implemented game scenes using the natural subjects (game group). The order of events proceeded as follows:

1. The children were given a talk on how to draw characters and what was required of them to create stories or games about their character in a natural setting.
2. A template was given out to guide the work and make it more understandable for the children, making it a step by step process, this is shown in the Appendix, item 8.5.4.

3. The children drew characters, based on choosing their favourite natural thing, then created either a story or a game.

4. A group of 6 or less pupils were supervised by a teacher, teaching assistant or myself. Notes were made about the conversations and, where permission was given, an audio recording made.

5. The results were subsequently analysed; common storylines or features identified, along with any further information from the discussion and related to emotional needs.

The objectives were to:

- Gather data about preferred characters and stories.
- Further investigate choices around natural subjects.
- Get a perspective on children’s latent needs as they talk about the feelings or needs of the character they design.
- Identify their key emotional needs from the stories they create.
- Compare the character and story (CAS) method, with the usual default co-design method to ask children to design a game, considering the child’s understanding of the task and how effective each was at providing the above data.

4.3.4.1 Ethical procedures

Permissions forms were presented to each child for their work to be used in the research and recordings or photographs taken during the process; only three were not signed by parents, an example is provided in Appendix, item 8.5.3, along with the information forms for parents (8.5.1) and children (8.5.2). Six children were working with one adult helper. This ratio avoided the children feeling intimidated, as they might with a one to one ratio, or that the adult was in control of the activity, in-line with Naranjo-Bock’s advice (Naranjo-Bock, 2011). All of the adults involved were DBS checked.
4.3.5 Results: 2 i) CAS method

4.3.5.1 General observations about the method

The children were able to engage in the tasks, according to their feedback, and the observations and feedback through the adult helpers. Most could fill out the template for activities and complete the work satisfactorily suggesting both methods were understandable. Three children with special needs required extra help from the classroom assistant in the ‘non-game’ group 1 from the ‘game’ group, but happily were able to complete the task. The children found the simple story based, non-game variation easier to grasp from the preliminary instructions and needed less subsequent clarification. For both the game and non-game template groups, information was gained about their preferences for the natural things they chose and reflected upon during the process. A useful range of stories that could be later implemented in the game emerged from both methods.

However, for the group that were asked to design a game from the beginning, there were examples of characters and stories that were derivative of existing productions, for example, one of the girls created a central squirrel character for a game she called ‘squirrel craft’ which appeared to be a reference to ‘Minecraft’, a popular game for this age group, example shown in Figure 4-12. The adversary she chose is ‘creeper’ which also features in Minecraft (Davis, 2018).

![Figure 4-12 A character that appears to have been influenced by ‘Minecraft’](image)

Some focused on describing ‘in game’ assets and procedures, rather than on the narrative aspects of the task that they were asked to. The information gained from
the task was mostly qualitative, though numbers choosing particular natural
subjects were counted, to justify their use as acceptable content. Often the
discussions around the activity were a useful way to gain empathy during the
activity, along with the drawings of characters and scenes produced. The text
added to storyboards was not always clear, possibly due to the developmental
stage and difficulties with writing. Both methods appeared to be engaging to the
children.

There was evidence that children were able to express emotional issues during
the CAS process. Two examples of rather sad stories illustrate this point. Figure
4-13 shows a story about a fox; the child describes a father fox character as ‘bad’
and ‘doing nasty things to animals’ and in the final scene the father fox abandons
his son tied to a tree in the wilderness, because he ‘screws everything up’. It is
not possible to suggest that this refers to a real experience, however, the child
was expressing emotion and empathy during the process.

Another story featured a bug who goes in search of friends, tries to talk to a
character and they just ignore him. This was sketched by a boy who is known to
struggle socially.

4.3.5.2 Implications for design research: methods

The findings backed up earlier investigations about the CAS method, in that it was
easy to understand and a way to access the child’s thoughts. Conference papers
were written that discuss the validity of the CAS method in more detail, provided
in the Appendix, items 8.2.3, 8.2.4 and 8.2.5 (Grundy et al., 2012, Grundy et al.,
2013, Grundy & Howland, 2014). It was therefore concluded that the CAS method
was a useful way to address the follow issues: IT7 How can we predict and address the emotional needs of the player to support an optimal experience for this context? IR1. What kind of characters and narratives are appropriate to the game?

4.3.5.3 Character designs

A series of different animals were chosen as characters and are listed in the Appendix, item 8.5.6, along with whether they are considered ‘good or ‘bad’ and were a lead or supporting character. Though this was not intended to be a quantitative study, the findings can indicate which creatures would be acceptable to include in a game and are known by many of the children. For example, rabbits were chosen 10 times (always as ‘good’ characters). Perhaps surprisingly, given how rarely they are seen in the wild, snakes were the most commonly included creature, 15 times altogether (as a ‘good’ character, in 10 cases). In conversation, these children seemed very conscious of the presence of adders in natural environments. Foxes were also chosen seven times (4 times as a ‘bad’ character) and three children mentioned they were afraid of them. Insects were also chosen 9 times. Another discussion involved a bat character, he “likes to suck blood a lot, but that’s ok.” this character was labelled as ‘good’ but attributed with ‘nasty behavior’, when not feeling confident. The child was fascinated by bats in the conversation, though also afraid of them. In general, the characters were based on general terminology e.g. ‘butterfly’ or ‘bird’. Only two children showed knowledge of specific species, for example: blue tit or African sand spider.

Figure 4-14 Character labelled ‘blue tit’
4.3.5.4 Story themes/ emotional needs

A breakdown of all the stories is provided in Appendix item 8.5.7. For 10 of the stories, themes of fear or vulnerability within the natural environment were noted. A typical example included a deer character encountering an evil elf and overpowering it in the end. One particular quote was: ‘he (the elf) hides behind trees and attacks people’; the conversation around the drawings revealed a perception that ‘scary things’ can happen in a natural environment and this was an example. In a different example, about a rabbit and her friend the butterfly, characters are initially afraid of a fox, but in the story, they overcome their fear and become friends with the animal.

There were references in the stories that allude to ‘winning’. 29 of the children mention winning a battle against an adversary. Of these, 7 characters found or made weapons from natural things around them. Five describe a form of power struggle over possessions, for example, fighting over gold, or a residence. Gold and diamonds and other rewards were mentioned on 14 occasions. 10 of the characters found different objects with ‘superpowers’, to help them overcome their nemesis, such as slime power when meeting a slug to help them slip away easily. Three of the children mention their character being regal or having status above the others; either a queen, princess or a king, depending on gender. Other references include: ‘taking over the world’ in 9 cases. Wizards were introduced in 4 scripts, and magic was a common theme, present in 13 scripts.

Helping sick animals appeared in 5 studies and 2 games suggested collecting natural things to make a magic potion that might save them. There is frequently talk of ‘saving characters’ where they have been captured or ‘saving the day’, portraying a character as a hero performing altruistic deeds. For 32 stories in total, friends work together to ‘win’ battles or properties, ‘trick’ baddies or ‘save’ each other.

There are also 8 stories about characters spending time with friends. Parents were also included in 2 of the stories. Family ‘Homes’ are also mentioned, in 8
scripts. These stories possibly reflect a need for a protective element from friends and family.

Figure 4-15 Story that Involves Creative Activity to Design a Home.

For one story, detailed accounts of making a new home with natural things were given, as shown in Figure 4-15. The children were also very keen on food related subjects (9 scripts), with 4 children referring to the character exploring and choosing natural food an animal might eat, 5 others to cake or sweets. 10 of the stories include references to the character exploring or looking around for things.

4.3.6 Implications for Design Research: 2 i) CAS

The results pointed again to the child’s interest in animals, repeating findings in phase 1, with the majority choosing them as lead subjects, referring to: IC14. What kind of natural content is preferred? The subjects identified by the children are therefore familiar and are considered acceptable for adding to PBMG prototypes, supporting the issue: Which characters are preferred for the game? Where possible further information about the specific species should be added, to promote learning, in line with the suggestion of SWT experts, phase 1.

Including potentially frightening subjects, like snakes or foxes, or those that children are averted to like insects could help to overcome latent fears about the environment, helping to consider: IC 1.2 What are children afraid of and how can it be overcome? This is similar to the effect noted by Del Vechio (Del Vechio, 1997), where ghosts and ghouls are included in games because it helps to regain
feelings of control, therefore also helping to answer: IT11. How can feelings of ‘control’ be promoted through the game?

The desire to be powerful was noted as a theme for most of the stories, examples included winning, fighting, gathering possessions or gaining in status. Wizards and characters with regal status also had powerful connotations. Competence needs can be supported through the reward systems embedded into the game, such as collecting gold or getting positive feedback from other characters. Some of the stories also related to showing competence through skills; these factors addressed the issue: IG9: How can challenges promote feelings of competence and mastery? Power was also discussed by Del Vechio (1997), who suggests that children of this age have relatively little power or control over their normal lives. This also reflects studies by McGonigal (2010) about how people feel more powerful in a computer game environment when they able to ‘save the world’. Competence and power are described as critical emotional needs, according to the PENS group for computer games (Rigby & Ryan, 2011) and Del Vechio (1997). Power and competence therefore both appear connected to feelings of control, a significant element of flow theory.

Gaining ‘power’ during the stories, was seen through examples of obtaining a super-ability, casting a magic spell or gathering weapons. An interesting point is that natural objects were frequently used to help gain this power, triggering chosen ‘superpowers’, mixed to create ‘magic potions’ or to make the ‘weapons’. This could be a potential way to connect children with nature. In some cases, this could enable learning about medicinal use of plants or making practical objects from natural materials. This points to the identification of a new issue: How can the core mechanics of the game help to immerse the player in the environment? Alongside: How can the narrative of the game help to immerse the player in the environment?

In the original survey of children, food was mentioned as a motivating factor to visiting the country and was mentioned in several of the children’s stories. It would be unsafe to suggest foraging for edibles, for safety reasons, however, gathering
virtual food in the game might be an alternative. Building homes for creatures in nature or dens for safety was also another possible lead for game content, considering: **IC2. What kind of activities and play types can be transferred to the game environment?** Educationally, building animal homes could teach children about where they live and collecting food rewards support learning about what animals eat.

Another major theme involved factors that were nurturing, protecting or comforting, to overcome any fears or challenges they may feel about the environment. Friends or family were mentioned in over half the scripts, alongside returning to the comforts of home, or defeating a challenge to their home. This might point to cooperative play with others, but as discussed in Chapter 2.3, this is not always possible for safety reasons. The game could therefore be designed to compensate, with the addition of virtual friends in the game environment, using characters they generally identified as friendly. This also helps to meet the emotional need for ‘relatedness’. The inclusion of friendly characters and a cooperative plot represents a part solution to: **IG5. How can a social dimension be safely added to an LBMG?**

A summary of the main storylines and how they possibly relate to emotional needs is included in a final summary at the end of all activities for this phase.

**4.3.7 Key findings: 2 i) CAS**

- CAS helped to identify favourite natural subjects, animals, in particular and examples familiar enough for children to include in game content.
- Control is an important component of Flow and can be seen to be interpreted in different ways for children, for example, through achieving power (winning battles), status (becoming king), having autonomy (gaining freedom) or impact (saving the world).
- Children also discussed fears of the natural environment through their characters and stories, by including frightening creatures or overcoming challenging concepts. Overcoming fears is another way of gaining control.
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- The role of friends or supportive characters (parents etc.) in the goal of the story was also notable; the importance of friendship at this stage is also significant according to psychologists. Characters in the game could perhaps be an alternative to the involvement of other people, which may not be safe.
- In some examples, the plot involved using nature to empower the child, for example making magic potions, providing ‘superpowers’ or forming weapons. This may have potential for connecting young people with nature, supporting their need for power and control.
- Themes children commonly mention also include food and building homes, which may provide other opportunities to learn basic facts about what animals eat or where they live.

4.3.8 Co-designing a game

Further activities for phase 2 include co-designing the children’s own PBMG and the necessary stages leading up to it. A project was undertaken over three days with twelve children aged 10-11, from Fairlight primary school in Brighton in June 2013 in the classroom and in Stanmer Park. This allowed a contrast with the activity previously conducted at St Andrews, where children were a year younger and, in some cases, from a different social environment. There were 12 participants. The pupils worked in the same groups of three throughout, there were therefore four ‘teams’ and they performed a series of tasks that would lead to the final creation of their own games, using MORFO and ARIS. Over the three-days the project covered activities ii) to vii) which will be described in more detail.

2 ii) Photography in natural environments.
2 iii) CAS activity for their game.
2 iv) Playing prototype games prepared for them.
2 v) Creating game content using MORFO.
2 vi) Creating games in ARIS.
2 vii) Playing their own games.
4.3.8.1 Terrain

The terrain chosen was similar to that described for the SWT workshops in Phase 1, mildly undulating throughout, to ensure accessibility for the whole group; the habitat on the trail included areas of grassland, along with areas of woodland; some of the route had mud paths, other areas were less defined; there are some ponds in the park but these were not featured on the route (the area was roughly represented by a nature trail that had been previously identified and promoted through lottery funding by the Stanmer Park Preservation Society and therefore considered relatively appropriate for children). The area is shown in Figure 4-16.

![Terrain map of area for research, Stanmer Park](image)

4.3.8.2 Ethics

The activity was carried out with Fairlight primary school, alongside the Sussex Wildlife Trust, in a location they normally operate within. Normal protocols for their outreach to schools were followed, including a permissions form signed by parents, to allow children to engage in the activities and also to ensure their security. Children could stop partaking in any of the activities at any time. Extra permission slips to permit photography and record voices were also offered and all were signed. Examples of ethics information and consent forms are provided in the Appendix, 8.5.1 to 8.5.3.
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4.3.9 Procedure: CAS 2 ii)
Character design and story activities were undertaken, similar to those performed at St Andrews. A talk was given about character design and instruction given as before. The activity guide sheet is shown in Appendix item 8.5.5.

The objectives for this activity were to:
- reveal latent & emotional needs.
- identify story ideas for use in future concept prototypes.
- confirm further preferences about natural objects.
- start the process of creating content for their game.

4.3.10 Results: CAS 2 ii)
The lead characters that the children drew are shown in the Appendix, 8.5.8, along with the themes they chose to write about in their narrative. One observation was that a child who drew a squirrel with glasses, wore glasses herself and described her character as being ‘geeky’ and said it was “because I am”, which again pointed to the fact that some children were referring to themselves through the character.

![Figure 4-17 A cartoon squirrel that bore resemblance to its artist.](image)

In considering: IR1 What kind of characters & narratives are appropriate to the game? The sample was too small to note general trends, however the results repeated some of the findings from the CAS activity at St Andrews, a rabbit and squirrel were selected as friendly and a hawk and snake considered adversaries, considered slightly dangerous, addressing: IC 1.2. What are children afraid of? Three of the stories involve overcoming an adversary and one is about nurturing an animal, in both cases the theme of control can be seen and the player has ‘an
impact’ on the game, considering: IT11. How can feelings of ‘control’ be promoted through the game, e.g. allow a sense of autonomy, volition or choice? Natural objects appear as weapons in two of the cases and again, a magic potion to overcome the bad guy. A summary of how the different story types throughout the design research address different emotional needs is provided in the discussion at the end of all phases.

4.3.11 Key findings: CAS 2 ii)

- The narratives that emerged in the Fairlight primary group showed similar traits to those of St Andrews School, despite being a year older and from a different social environment, choosing similar known animals as friends and including potentially frightening creatures.
- The stories allow the player to have ‘an impact’ in the game, for example healing a sick friend or ridding the world of a bad character.
- Magic potions and making weapons from nature feature in these goals, again repeated solutions from the previous CAS activity.

4.3.12 Procedure: photographing nature 2 iii)

During this process, the children were asked to take photographs of natural objects in their group of three, chosen at preferred natural sites and any features that stood out to them. Each group was accompanied by either a teacher or a researcher. The trail specified by the Stanmer Park Preservation Society formed a basic route, but the groups were separated so that they did not copy each other’s preferred locations, Figure 4-18 shows them setting off. They were given one I-pad per group and one waterproof camera, the other team member was asked to take notes; they swapped devices at regular intervals. The sites chosen were automatically geo-tagged with the photographs on the I-pad and could later be used to create locations for the interaction on their game map. The instruction sheet is given in Appendix, item 8.5.9.

The specific objectives were to:

- allow the children to find preferred sites for the locations in their games
- to identify locations or features of interest and why they stood out to the child
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- to provide the chance to find more natural objects they were interested in.

Figure 4-18 Groups setting off in different directions.

4.3.13 Results: photographing nature 2 iii)

Two of the children had never visited natural spaces at all, one said this activity was a ‘big adventure’, providing an insight on the background of the children. Table 4-6 illustrates a sample of the subjects that were chosen by children for their pictures, the full set of examples is given in Appendix item, 8.5.10. This relates directly to issue: IC14. What kind of natural content is preferred?

Category a) in the table related to what SWT term ‘mini-beasts’. In observations, many of the group were initially intimidated or repulsed by the creatures, however they became quite interested after a time and often dared each other to hold them. Signs of where animals had been also featured prominently, such as fox holes or mole hills. Most of the children photographed ‘climbable’ trees and areas that could be hidden in or were a good vantage point, category b).

Symbolic objects or places that stirred their imagination were also featured, including dens that could hide a monster, secret signs and branches that became a magic staff, illustrated in c). The pupils enjoyed showing off their knowledge and some of the images illustrates this, describing flowers (including daisies, buttercups, and others) or finding nettles and their antidotes. Signs of new life
also figured as subjects, such as buds or catkins. The final subject type seemed to be only distinguishable by its visual properties, usually including strong contrasts in colour, lighting or texture, illustrated in d).

Table 4-5 Children’s Photography Examples

<table>
<thead>
<tr>
<th>a) Controversial creatures: images of what SWT term ‘mini beasts’ with children placing them on their hand.</th>
<th>![Controversial creatures image]</th>
</tr>
</thead>
<tbody>
<tr>
<td>b) Functional play and trees: the same dead tree was photographed by all groups along with other trees that afforded climbing.</td>
<td>![Functional play and trees image]</td>
</tr>
<tr>
<td>c) Symbolic play: Several children picked up a branch and used it as a staff. In the transcript of the conversation, they were talking about ‘power sticks’ and acting like wizards.</td>
<td>![Symbolic play image]</td>
</tr>
<tr>
<td>d) Visual contrasts: for example, a copper beech tree against a background of green.</td>
<td>![Visual contrasts image]</td>
</tr>
</tbody>
</table>

4.3.14 Key findings: photographing nature 2 iii)

- Signs of animals, such as mole hills and fox holes, could relate to the previously noted preference for animals in phase 1, i) and iii) and characters chosen for CAS throughout this phase.
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- The images and observations demonstrated at first hand a fascination with insects and mini-beasts. In the survey in phase 1 ii), children suggested such creatures were one of the things they hated or feared about the countryside. The theory that children enjoy overcoming their fears could again be relevant here (Del Vechio, 1997), related to: **IC 1.2. What are children afraid of?**

- ‘Climbable’ looking trees can be considered to project affordances, in line with the perspective forwarded by Fjortoft et al. (Fjortoft, 2004) which suggests that they are motivational and the photographs suggest they are meaningful to the child, addressing: **IT3 Which aspects of the landscape are preferred and can encourage play through affordance and feedforward?**

- Other subjects appeared to hold special meanings for the child, for example, there were ‘secret’ signs, ‘power’ sticks and creepy dens, which seemed to inspire their imagination, which supported the issue: **IT2.2 Which features of the landscape can hold meaning for the child?**

- The subjects in the children’s photographs can be further broken into signifiers, according to the trichotomy of Sanders-Pierce (Liszka, 1996). Those that afford functional play are index signs because they indicate what can be done with them; buds and seeds are indications of new growth; animal tracks indicate activity. Metaphorical icon signs include the associations they made with ‘human-like creepers ‘strangling’ the tree. ‘Secret signs’ have learned meanings and are therefore symbol signs.

- The children also took pictures where they had some knowledge of the subject, showing off what they knew during observations. This corresponds with supporting the issue: **IG9: How can challenges promote feelings of competence and mastery?**
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- Some subjects were visually striking, through contrasting colours or shapes that stood out in the environment, providing signifiers, which relate to the question **IT3.1 Which features of the landscape draw the player's attention (have more visibility)?**

**4.3.15 Procedure: testing AB prototypes 2 iv)**

This activity involved testing two pre-prepared concept prototypes; the games were created from guidelines that emerged from the literature, data from the ‘Framing the Problem’ phase, using some of the natural subjects chosen by St Andrews children in phase 2 i).

**The objectives were:**

- To compare how linearly sequenced vs. a player selected sequence locations affected the experience.
- To compare different media methods for delivering activity instructions.
- To compare media for wayfinding.
- To introduce PMBG’s to the children so that they were aware of what they would later create.

The testing was carried out in Stanmer Park, with children working in their existing groups, and one adult accompanying them. A holiday club leader from the SWT guided the session and provided nature advice across each group. A member of each group held the iPad, while also playing the game with the others, another member was given a video camera to record the progress and the third member was asked to observe and help the group. They swapped roles at regular intervals. Videoing their journey also allowed the recording of their voices. Notes were also taken after every observation. All pupils played both games, playing one game per day, to avoid too much exertion. It was particularly warm for the UK in June, which could also have increased levels of exertion, however as a maximum time was to be identified to make the activity comfortable for all, and the children could stop whenever they wanted, this was probably a good example of extreme conditions.
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4.3.15.1 Game format

Both games took the form of a ‘treasure hunt’ style game, with an overall game goal presented via an introduction video, followed by a series of five GPS locations that presented different possible activities. These were similar to the non-digital activities used by nature experts and were selected from the final matrix, of those suitable for non-guided digital play, shown in Table 4.3. A brief task analysis describing the sequence of actions to play each game helps to picture what is happening.

1. Press start game.
2. Watch the video about the overall game goal and instructions.
3. Map opens automatically.
4. Look for current location and first GPS point.
5. Walk towards the point.
6. When in range, indicator appears on screen.
7. Tap indicator on screen.
8. Read or watch the media presented.
9. Perform suggested activity or task.
10. Receive reward or feedback.
11. Receive instructions about what to look for next.
12. Repeat steps 5 to 11 until the overall game goal has been achieved.

4.3.15.2 Activity instructions:

To give instructions about an activity, two different forms of media were compared, one text based, the other an animation, based on an audio track, shown in Figure 4-19. This was to observe, at first hand, issues with head down interaction and reading text, highlighted in the literature review, and compare their suggestion to use video instead.
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Figure 4-19 Screen shots from the text description of activities and a video introduction

4.3.15.3 Game sequence and activities

One game presented the locations in a linear, numbered, sequence, the other game had a player selected sequence of locations, where children could visit in their preferred order. Different activities were included for each and the allowed time was 2 hours in each case. Both games included an icon on the map for one of the GPS locations with an image of what the child should look for to see if it would help with finding a location.

The following describes activities or media at the locations:

- The first location for both games included an animated character, with audio, created using MORFO (The MORFO App is described in Chapter 3). This introduced the game and what players had to do, it also included warnings about animals and other hazards.

Other Locations for Game 1 (linear sequence of play)

The following activities were presented in succession (text instructions are given in double parenthesis, video instructions are given in single parenthesis):

1. “Find the nettles and read the warning about them” (exploratory play).
2. “Find an elderflower” (using an image) “and find 3 other objects that are ‘delicate’ looking and photograph them” (exploratory play).
3. “Look under objects and find 2 mini-beasts and photograph them” (functional and exploratory play).
4. A conversation with a virtual butterfly ‘Hi, do you need some help?’ and answer their questions (social play). This character also gave further directions to the next point.
5. ‘Listen and record some bird song’ (sensory play).
6. ‘Find somewhere you would be able to hide if needed’ (deep play)

Locations for Game 2 (random sequence of play) included the following activities:

- “Find some berries and read the warning about eating them” (exploratory play).
- “Find three different colours of flowers and photograph them” (exploratory play).
- Have a conversation with a virtual ladybird, ‘Hi can I help’ and answer questions (through screen interaction) (social play). Then further video instructions to next point.
- “Find a dandelion and blow on it” (with an image) (sensory play).
- “Find a worm or a snail and touch it” (sensory play).
- “Make a home for a mouse” (constructive play).

4.3.15.4 Wayfinding:

The GPS locations were presented on the map in different ways for each game, shown in Figure 4-20, with numbers where there was sequencing. The map was the main source of location and feedback on progress towards each location.

![Figure 4-20 Different map annotations for random sequence (left) and linear sequence (right) also showing image icon for one of the points](image)

Within ARIS, game locations can be set to particular GPS sensitivity settings, dictating the proximity within which the player is able to view the relevant media. Settings for these games allowed the child to see the media when they were within 5m of the point. The interface provides feedback to the player to indicate that the
media is available and that they have 'arrived' through a red dot at the bottom left of the screen and a noise is emitted.

4.3.16 Results: testing AB prototypes: 2 iv)

The results will be discussed against the relevant issues investigated for this activity.

IC 1.1 How can children be safeguarded from real hazards and the information conveyed?
IC1.3 How can the information about safeguarding the environment be conveyed to the player?

From observations, the children listened intently to the animated video at the first location and, from their subsequent behavior and questions asked of them, had understood what was said to them.

IT9. What kind of media should be used to communicate intermediate and overall goals?

The children understood the initial video that outlined the overall game goal. During observations and through their feedback, the children also preferred information about intermediate goals to be given through the animated character, rather than text-based instructions.

IC2.1 Which traditional play activities and play types can effectively transfer to the game environment?

Observations showed that it was possible to carry out the activities that were selected as intermediate game goals at each location, without prompting by a human guide. However, in some cases, the adult with the group offered more information or encouragement out of natural enthusiasm, or pointed out examples relevant to the activity, for example types of flower. Though this was not part of the briefing, it wasn’t considered to skew the results and in all cases the child had understood the basic requirements of the task. The animated video was found to be easier for the child to assimilate than a text-based presentation for giving the instructions. This also supported information addressing the issue: IC9 What level of (physical and) cognitive challenge is acceptable for game tasks?

IC2.2 What kind of activities are preferred by the player in the environment?
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All of the activities were seen to succeed in engaging the children and promote interaction with the landscape. An order of preference here for the activities would be inconclusive, it is a small group and there are too many contextual variables, e.g. varied terrain. It is also not really necessary as the aim is to consider which activities are acceptable and will not inhibit flow. This issue was therefore found to be rather badly worded in the context of the project. However, activities that stood out and were mentioned include the bird song (sensory play), ‘talking’ to virtual characters and activities that involved real creatures, such as mini beasts.

IG3. What kind of duration should the game and activities be?
The game tasks took between 15 and 40 minutes, in line with activities presented by experts in phase 1. These timescales were noted as suitable for maintaining physical effort, however the children’s attention span was noted to wander after around 30 minutes. Children started to play their own games and got distracted by the environment, climbing trees for example.

The whole game duration could, in theory, take up to 2 hours, though the children could stop at any time. This was suitable for most of the participants, except for one child who started to become tired after about 90 minutes, this could have been due to excessive heat. Additionally, an approximate distance between points that appeared acceptable during testing was 30 m, with a tolerance of 5m to find a location before it notified the player.

These findings were also found to be informative for the issue: IC9 What level of physical and cognitive challenge is acceptable for game tasks? Unfortunately, due to the terrain and health and safety concerns, presently the game is less suitable for children who may have lower levels of physical ability. The guidelines created are based on standard abilities for this developmental age, discussed in section 2.3.7.1. It is suggested, however, that future research could be done to create alternative versions of the game that could meet the needs of children with levels of physical or cognitive ability, not typical for this age group.

Wayfinding
During the literature review and from observations in phase 1, it became apparent that a major challenge when playing a PBMG is wayfinding in natural terrain, therefore a series of issues relate to this:

**IG7.1 What kind of map is preferable?**
During play, the children could choose between the street map or terrain map, in all cases they chose to reveal the terrain to show the detail of the landscape.

**IG1. How do GPS reliability and other technical constraints impact on the experience of play for the environment under study?**
An observation was that every group, at some stage, found it difficult to read the map to locate themselves and when this was combined with the lag on the GPS system, on occasions, some walking was necessary before the correct direction could be established. It made it hard to concentrate and undoubtedly affected the experience adversely.

**IT4.2 How should the game provide feedforward to guide the player?**
The animations, with an audio track to tell the player where to go were preferred to text instructions for finding a location. Having an image on the map that could be enlarged to indicate a location or a natural subject to be found also helped to locate them. This is also appropriate to the issue:

**IT2.3 Which media types avoid excessive head down interaction with technology?**

**IG4. How does the sequence of activities and number of events affect the experience?**
Comparing the two games, the version with a linear sequence and numbered locations was more quickly navigated than the random sequence, where the children could choose the order of locations. There was some confusion and arguments about which points to visit in the random sequence and this was exacerbated by problems with GPS and working out where they were in relation to the points. The linear sequence also allowed better concentration on the game goals, however, the children did not enjoy doubling back to an area of terrain they had already seen, they preferred to carry on to new places, when the linear version necessitated this.
During game play and photographic studies, different extremes of weather conditions were experienced. On one occasion children experienced a very hot day, on another it was raining. The experience of play was not seen to be significantly impacted, however, although the heat may have made crossing the terrain more tiring, children were able to stop at will and seek shade. Protecting the technology with a waterproof cover allowed play to continue when raining.

4.3.17 Key findings: testing AB Prototypes: 2 iv)

The following initially addresses general concerns about safety and the specifics of the case. The rest of the discussion is categorized according to the pre-requisites for a flow state and immersion.

General Concerns:

- A video at the beginning proved to be a suitable way to replace the human guide to introduce information about safety in the environment, a requirement discovered during the literature review and protocols to protect nature, discovered in phase 1. However, this technique should be further tested with a different group of children during subsequent phases, as it is vital to the wellbeing of the player and the environment.

Clear Goals

- The animation at the beginning also introduced the overall game goals and proved to be an engaging way to achieve this.

- The intermediate game goals were based on activities offered by the nature experts drawing from literature in Chapter 2.3 and field observations of SWT holiday clubs. The testing evaluated the media to ensure children could understand the activities when implemented through a PBMG, without a human guide. The children conclusively found it easier to be given their task instructions through an animated character (using an audio track), rather than through screen-based text, which was in-keeping with findings in the literature review in chapter 2.3. Successful completion of the game activities by children provided several examples where the intermediate game goals were clear.

Levels of Challenge
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- The duration of the activities and distances travelled will influence levels of physical and cognitive challenge. The evidence from AB testing points to placing an upper limit on the overall game play time at approximately 90 minutes, to avoid over exerting the child and this will be implemented in further game prototypes. In this respect, it was also of benefit that they be able to stop and start the game and rest when required in order to maximise engagement, backing up conclusions from the literature review, that a race against time game pattern should be discarded.

- The duration of the intermediate game goals was indicated by the non-digital activities used by experts, discovered through literature in Chapter 2.3 and observations in phase 1. This was between 15 to 40 minutes; an upper limit of approximately 30 minutes was found to be better for concentration, but this will be further tested in subsequent games.

- A distance between points of approximately 30 m was acceptable and will be used in further testing and for implementing in the children's games.

- Wayfinding was noted to be one of the biggest challenges during play. This was an issue raised during the literature review, chapter 2.2, as being pertinent to PBMGs generally, but is also compounded by the properties of the natural terrain, observed in phase 1 and also the dependency on GPS response. The sensitivity setting of the GPS allowed the child to interact with a point of interest within 5 metres of its exact location and was acceptable. This will be further investigated in phase 3.

- Other matters relating to media and wayfinding were noted to be heavily influenced by where the child placed their attention and are therefore considered as an element of concentration.

- Different weather conditions were experienced. Because the search and find pattern has been adopted, children are not playing the game against the clock. This proved advantageous because they could stop at any time and seek shade or shelter.

**Concentration and Balance of Attention: Wayfinding**

- A balance of attention, important for concentration was found to be particularly difficult during wayfinding, which required considerable head down interaction to follow the GPS point on the map. This echoed the
observations of previous researchers, discussed in chapter 2.2 (Eliasson, 2011; Avouris, 2012).

- Ironically, wayfinding difficulties also disrupted attention away from the screen and the PBMG: after a while, when some children could not find their way, they stopped concentrating on the game altogether and started playing their own games.

- An animated audio track describing how to set off on the next part of the journey was helpful and interpreted more easily than a written description. However, head down interaction was still significant and appropriate media should be further investigated to avoid impacting on flow.

- A terrain-based map contains more visual cues (feedforward) to indicate what lies ahead than a street map. A fantasy map, such as the type provided with Pokemon Go! (Das Gupta, 2016), is even more abstract to interpret and was therefore ruled out for this location.

- Adding an image on the map that could be enlarged to provide extra visual cues when finding a location or a natural subject was noted to encourage the player to look at the landscape. It was therefore decided to further experiment with contrasting different media cues to help with this aspect of wayfinding.

**Control**

- Control can be related to pragmatic aspects of the player being able to direct the game play and also the feelings of being in control during the game. Issues related to GPS and wayfinding issues may also be connected to the player directing the game play.

- The activities chosen addressed different play types according to the literature (Frost, 1992; Hughes, 2002) and therefore they had the potential to address a range of emotional needs (Lazzaro, 2004b; Rigby & Ryan, 2011), which were shown to be related to feelings of control, during the CAS method earlier in this phase.

**Control: Competence needs**

- Activities that included constructive play, tasks to overcome fears (with insects, for example) and where knowledge was demonstrated were all
enjoyed by the children and hence assumed to be meeting competences need.

**Control: Autonomy**

- Activities where exploratory play was included and the exploration as part of the game was enjoyed by the children and assumed to be meeting needs for autonomy.

- It is previously was assumed that children would prefer a random sequence of locations, where they could choose the order in which they visit locations. This would suggest having more autonomy over decisions and control over actions. However, the linear guided sequence was preferred. This could have been due to the activity being carried out as a group, as some disagreements were noted about where to go next. Children enjoy being the chooser as well as having a choice, according to Del Vechio, (1997) and this can cause arguments and power struggles. Alternatively, it could be due to the guided sequence being a simpler idea in an already cognitively demanding situation, therefore presenting a more appropriate level of challenge. Whatever the case, the game should be playable by pairs or trios of children, to meet relatedness needs and therefore a linear sequence is adopted for concept prototypes in future.

- The fact that the children did not wish to double back to locations they had already passed through possibly indicates they want to discover new terrain, another representation of a need for autonomy, according to Rigby and Ryan (2011).

**Feedback**

- Feedback to inform the player about what had been achieved also helped to support competence needs during activities and ideally rewards would be offered. The role of rewards will be considered during the next phase.

- Feedback about screen-based activity, such as tapping a media icon requires an immediate response and was effective through the usual ARIS interface.

- Feedback about arrival at a destination is required, when close-by and the mechanisms within ARIS proved adequate for the players.
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- Several of the concerns related to other pre-requisites can also be seen to relate to the pre-requisite for ‘**Feedback**’. For example, poor GPS response relates to giving poor feedback about location and influences both levels of challenge and concentration.

**Immersion**

- The activities created by nature experts transfer satisfactorily to the game environment as intermediate game goals and each encourages interaction with the landscape in different ways. In some cases, they can be considered to be promoting physical immersion, others may involve sensory play and therefore visceral immersion.

### 4.3.18 Procedure: game co-Design MORFO & ARIS 2 v)

Here the children co-created their games to make a playable prototype for Stanmer Park. **The objectives were to:**

- Observe and discuss the type of activities they had chosen to include
- Observe further pragmatic game issues that arose during the playing of their games

**The following describes the stages of development:**

1. The children were asked to animate the characters they had drawn in the CAS activity or photographs they had taken using the MORFO animation App, to make into game content. The characters were intended to offer audio instructions to a player once added to the game.
2. Place their media content in the locations they had previously identified, using ARIS, the game engine described in Chapter 3 to create a sequence of activities in a treasure hunt style.
3. The pupils were then able to play their own game out in Stanmer Park while a team member videoed their progress.

### 4.3.19 Results: game co-design MORFO & ARIS 2 v)

Data about children’s preferences or emotional needs gained from this part of the procedure was not as rich as for earlier methods; this was due to a focus on the technical part of game development and time spent on learning the packages required. However, creating a game represented a tangible outcome to
demonstrate the results of their work. The groups completed two or more MORFO videos each, examples in Figure 4-21.

All groups managed to successfully create a game with ARIS of some form and most children were engaged with the task, according to observations and their questionnaire responses. However, ARIS proved a time-consuming interface for some young people to use. Mostly the groups were only able to place between two points to four points on the map, with their associated media. Sometimes the children had located points in difficult to access locations and they had quite random distances between them, between 5 and 50 m. The distance between points and having an accessible location was also noted to influence enjoyment.
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According to two of the children's comments, they didn't feel that their own drawings made it a 'real' game. When questioned, this was because they were expecting to have more professional looking graphics in the final games.

4.3.20 Key findings: game co-design with MORFO & ARIS 2 v)

- The children found using ARIS time consuming and tricky. Learning the software and creating the games over a longer period of time could be helpful. Providing approximate GPS locations for building the game could avoid some of problems related to inaccessibility of the points of interaction and constrain some of the decision making, to save time. The procedure in phase 3 was altered accordingly.
- Issues with wayfinding, discovered during AB testing, including GPS reliability were confirmed during the playing of the children’s games.
- Preferred graphical styles for characters should be included in investigations to make a more finished looking game, alongside how to improve wayfinding and the balance of attention.

4.3.21 Conclusions phase 2

A review of findings towards the pre-requisites for a flow state and immersion in the game are discussed in the following section and the consequences for investigation in subsequent phases. To avoid repetition, how data from this phase addresses the detailed issues and solving the wicked design problem will be discussed at the end of the design research phases (after phase 4).

4.3.21.1 Levels of challenge

The activities selected from those offered by experts were achievable by the children and they are therefore at an appropriate level of physical and mental challenge for the game, transferable to a PBMG and can allow a flow state. Pragmatic design guidelines were discovered to address levels of physical and cognitive challenge, include the duration of the whole game (90 minutes) and intermediate game tasks (15-30 minutes). A distance of 30 m between points was noted to provide a reasonable distance between locations and setting the sensitivity of the GPS at 5 m allowed the participants to ‘find’ a location within
reasonable proximity. These guidelines help to establish basic playability parameters, to avoid detraction from flow conditions. A linear sequence of points was also found to be easier to follow than a player-selected sequence, possibly due to the increased level of challenge that the latter would represent. These settings will be carried through to the next phase of investigation for further investigation.

The most challenging aspect of the game was wayfinding; this is one of the more repetitive elements of the game and potentially disengaging, therefore the cognitive load associated with it should be further reduced. A terrain-based map was found to contain more visual cues (feedforward) to indicate what lies ahead than a street map. A fantasy map, such as the type provided with Pokemon Go!, is assumed to even more abstract to interpret and was therefore ruled out.

Issues around wayfinding were also observed to be influenced by where the attention of the child was directed, across the virtual and physical world and therefore, this issue is further considered under the flow pre-requisite category of concentration.

The game is currently directed at children with physical and cognitive abilities typical of this developmental age. Further research would be needed to create games that address children of non-typical ability.

4.3.21.2 Clear overall and intermediate goals

The animated characters with audio instructions, used to present the overall game goals and the game activities, were understandable and enjoyable to the player, and preferred to the use of text. Similar media will therefore be adopted for concept prototypes in phase 3.

It was suspected before the research for this phase that a video providing a demonstration of an activity might be a useful addition. However, this did not prove necessary for the activities included and would encourage more head down screen interaction. The animated character is also more in-keeping with the look
and feel of the game. However, if a more complex activity is to be included, this is a possible mechanism for communicating the actions required.

So far in the investigations, the intermediate goals have not been related to an overall game goal, through a narrative or other type of conceptual model that would link their meaning. For this phase the game simply had to be completed with all locations visited. Comparing the role of narrative through ludic and story-based means will therefore be a consideration in the following phase.

4.3.21.3 Control

The investigations for this project pointed to the significance of players feeling in control, beyond the practical side of controlling game play through directing the action. Through the CAS process, useful information emerged about the emotional needs of the child for this context of play. Addressing such needs in a game could increase the player’s sense of volition to overcome the inherent challenges presented, according to researchers (Freeman, 2003; Lazzaro, 2004a; McGonigal, 2011; Rigby and Ryan, 2011). Having a strong sense of purpose has been related to an emotional need for autonomy by Rigby and Ryan (2011) and this can also relate to having an impact in the game; illustrations of this need, articulated in the children’s stories, included themes of: ‘saving other animals’, ‘rescuing the forest’ and ‘curing a sick animal’. Basic achievement of the game goals and progress in the game have been associated with meeting a need for competency. Choosing to address game goals, with a sense of volition towards them and a feeling of competence on successful achievement of goals are both aspects of feeling in control during the game. Findings, through the CAS process, discussed below illustrated this correlation between the key emotional needs for autonomy or competence and ‘control’, the pre-requisite for flow.

There was significant evidence through their characters and stories that children at this developmental age have a desire to overcome fears within this environment. Examples included the use of snakes as friendly game characters in their stories and enjoying the activities that involved interaction with insects and ‘mini-beasts’, despite the children revealing their latent fears of them in the wild through other methods. Winning battles or power struggles for possessions were
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also a common theme in children’s stories. The desire to be (or appear to be) more powerful through the game, in order to succeed in missions was illustrated through various mechanisms including: ‘power-ups’; gaining magical powers or weapons. These narratives are associated with a need for mastery or competence needs in the Rigby and Ryan model (2011) but also represent having control over the proceedings.

Exploring the physical world and the ability to enter fantasy worlds where they may have more ‘control’ than real life, were activities that the children were seen to enjoy, during observations, and are also examples of meeting needs for autonomy.

Stories where friends and family were supportive of the player and help to achieve the game goals were also frequently produced, these are likely to be supportive of the emotional need for ‘relatedness’; this is not directly associated with control and is discussed separately.

In AB testing, a linear sequence of GPS locations was preferred to a player-selected sequence. In theory, a random series of points, where the child is able to choose their next mission and the direction of travel should have appealed to autonomy needs. Several theories were discussed in this section and a full investigation into the reasons for this are not within the scope of the project, but this may have been influenced by the high levels of challenge inherent in the PBMG and the complexities of group decision making. A possible theory emerging is that the child is more likely to be able achieve their goals, addressing competence needs, for the relatively simple linear sequence and that this has overridden the need for autonomy. For now, the linear sequence is adopted for future concept prototypes, noting that if other aspects of play were simplified, more autonomy may be preferred.

Due to the importance of emotional needs for this project, further investigation, through CAS and other methods, will continue into phase 3.
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4.3.21.4 Relatedness

Relatedness is discussed by the PENS group and considered to be the third main key emotional need. This is also discussed by Norman as ‘relational’ and was included in the experience map. Being connected to friends and mutual support has arisen frequently through the story investigations, suggesting the importance of this to children. Where it is not safe to promote contact with real people through the game, the potential to have friendly supportive characters in the game may help to compensate. In the game trials, working alongside other children helped to facilitate this, but the presence of other children would not be guaranteed in the event of implementing similar games. This technique may also serve to connect the child more with natural concepts; exploiting their love of animals, for example.

This factor did not appear explicitly within the flow model, due to its ability to both engage and distract and affect concentration, though it was recognized by Csikszentmihalyi (2002) as significant for happiness. Adding ‘friends’ through the game is also less likely to form a distraction.

For this context relatedness could also relate to the child’s predisposition to nature and how it influences their desire to overcome the challenges inherent in the game. These attitudinal factors could be considered as a will to be connected, either to people, objects or places and, provided guidelines are added to avoid distraction, would positively affect Flow for this context. This may also indicate its connection with the concept of Immersion.

4.3.21.5 Concentration (attention)

Concentration is related to attention (Norman, 1969). Wayfinding was found to be one of the more critical aspects influencing the flow state, due to the high levels of challenge it presents, but also its impact on the balance of attention across the virtual and real worlds. Considerable head down interaction was required to follow the GPS point on the map, echoing the observations of previous researchers, discussed in chapter 2.2 (Eliasson, 2011; Avouris, 2012). When trying to find a location became too difficult, ironically, children stopped looking at the screen or concentrating on the game altogether and started playing their own games.
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It was noted that there are three different use ways to use media representations to direct the player:

1. Icons to show a location on the map (limited to a word and/or image in most LBMGs)
2. Media to direct the player to the next point after they have carried out an activity (a written description, an image or video in current LBMGs)
3. Visual feedback about arriving at desired location (ARIS deals with this automatically as the point becomes accessible and notifies the player).

It became apparent for avoiding head down attention with the device, that the most critical use of media was how the player was directed between points, noting particular difficulties using the map at the start of their journey, to gain their bearings and the delay of GPS signal to give feedback about progress.

**Feedforward and affordances:** The balance of attention during wayfinding also depends on the use of signifiers and affordances, both on screen and in the landscape. In the literature review affordances in nature were found to be influential in motivating a child’s behavior (Fjortoft, 2004) they were also discussed by Ritchie (2014) for mobile stories suggesting that the game play in a physical world can be directed by them. Using meaningful affordances and striking visual features in the real world, could therefore draw attention back to the natural environment. Considering the images taken by the children, a series of trends were spotted that could help to define meaningful locations that may support their recognition. The influence of affordance and signifiers are investigated again in later phases.

**4.3.21.6 Feedback**

The GPS signal does not always give immediate feedback about location and this impacted on the flow of the game, ways to overcome this are part of the next investigations. When the player arrives at a destination, they receive useful feedback that the point is available and are able to access the media.
4.3.21.7 Immersion and flow

It was noted that levels of immersion can be considered through the previous categories of flow pre-requisite and this related to both playability and experience goals. Playability, for example will be influenced by the pragmatic qualities of the game and how they meet the cognitive and physical ability of the player. Maintaining concentration will depend on the balance of attention across the two worlds, which will, in turn, depend on levels of playability and how the players attention is drawn by both the real and virtual worlds. The players level of engagement and motivation to overcome challenges will be influenced by how the game meets key emotional needs. Therefore, most of the previous points help to address immersion, which appears to be therefore synonymous with a flow state.

However, some of the activities chosen were also seen to contribute to a state of sensory immersion, especially those that encouraged the player to use a range of senses, for example, listening to sounds or touching natural textures. Using features of nature to support feelings of being powerful and in control could be a good way to emphasize its positive qualities.

Constructive play tasks can relate to the natural world, appealing to competence needs and other tasks, such as finding food or building homes out of natural materials could be related to facts about what animals eat or how they live. Relating the game goals to the natural world could also be seen as a mechanism to connect children with the landscape.

4.3.22 Proposed design guidelines

The following summarizes design guidelines that are proposed as a result of this phase and will be taken forward for further evaluation in phase 3.
Level of Challenge (Pragmatic dimensions)

- The total duration of the LBMG should be less than 90 minutes.
- Intermediate activities should be between 15 and 30 minutes.
- Locations should not be more than 30m apart.
- A linear sequence of locations should be used to make game play more straightforward.
- Include activities that are understandable and safe without a human guide.
- Using a terrain map allows more detail to be provided and more landmarks to help with wayfinding.
- Set the sensitivity of the GPS point to 5m (or more) to make objects and locations easier to find.

Clear Game Goals

- Include safety instructions about potential hazards in nature and protocols for preserving the environment at the beginning.
- Avoid the use of text to instruct players about overall and intermediate game goals, the use of animations or audio is preferable, if sound is audible.

Game Content:

- Include virtual animal or mini-beast characters in the absence of specimens in the real world.
- Include familiar creatures but also introduce specific species names where possible.
- Use locations or objects in the game that offer meaningful affordances and signifiers to the player, they can be used to indicate action (index signs); offer metaphorical associations (icon signs) or add reflective meanings based on experience (symbol signs) to increase interest.
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Concentration and Balance of Attention

Wayfinding:
- Map icons should include images of locations or items to be found, along with a text description to avoid ambiguity.
- Use locations that are visually striking or have meaningful affordances to aid with recognition and wayfinding.
- Use media appropriate for the developmental age to provide directions, including animation or video.

Control

Where Competence needs are emphasised:
- Provide opportunities to display knowledge and understanding about the environment.
- Include a range of play types that can match the skill level of the child to allow them to demonstrate their ability.
- Promote a sense of achievement and mastery through the game play.
- Include constructive play types to allow the player to show their ability.
- Address the child’s need to feel more powerful, through the narrative, providing opportunities to ‘win’, or to increase their status through the game.
- Narrative themes children enjoy, that can support feelings of power include, the use of magic, gaining superpowers, or having weapons.
- Including creatures that children find intimidating as characters or through the narrative can help to overcome latent fears and the player to feel more masterful.

Where autonomy needs are emphasised:
- Include opportunities for exploration through activities that promote exploratory play types.
- Where autonomy needs are emphasised, allow the player to choose objects or characters as part of the game play.
- Where autonomy needs are emphasised, create a sense of volition in the player, through themes such as gaining freedom for the player or other characters, saving the forest, saving animals or conducting another important mission.
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**Feedback**
- Provide rewards for achievement after intermediate and overall game goals.
- Notify the player when they have arrived at a location.

**Immersion**
- Include activities that promote physical or sensory play to promote interaction with the landscape, typified by non-digital activities used by wildlife experts.
- Include preferred subjects, such as food, in the game play, this could also be related to what animals eat and knowledge about nature to immerse children in the subject.
- Increase engagement with the environment, through the narrative by including natural objects in the game to support feelings of power and control.

**Relatedness**
- Include supportive characters as friends or family to support the player in the game play, to add a social component safely.

**4.3.23 Further Emerging Issues:**

| IR3 | What kind of graphical style do children of this age prefer? |
| IR4 | How can screen attention be reduced for wayfinding?        |
| IR5 | Is the narrative best included through a storyline or through a more ludic approach? |
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4.4 Design Phase 3: developing concepts

4.4.1 Overview

Phase 3 was similar in its approach to design Phase 2, in that it again involved primary research and working alongside children and nature experts, to gain their perspective on the design of PBMG’s. The child was again an ‘informant’, according to Druin’s classifications (Druin, 1999) and contributed as a ‘tester’ when playing games created to evaluate previously established guidelines.

Findings from Phase 2 were evaluated and emerging issues arising were included in the investigation. Proposed guidelines formed during Phase 2, such as appropriate durations or linear sequencing, were implemented into concept prototypes to further evaluate with players. Wayfinding, in particular, had been found to be difficult, indicating a need to further explore appropriate use of media to improve the balance of attention and concentration.

It was also important to consider further how the enticing properties of the game encourage the child to overcome challenges, through meeting their emotional and control needs. To this end, preferred stories were evaluated, and further CAS methods applied, to see if new information would emerge. Game structures with different relationships to a narrative were also considered, addressing how they may influence the volition of the player to overcome game goals, comparing a ludic and story-based approach. The look and feel of the game was also explored, through character designs, as previous evidence had suggested it influenced a child’s first impression of the game and therefore their subsequent engagement with it.

The aims of this phase were to:

- Evaluate previous findings from Phase 2 and affirm related guidelines.
- Further explore emotional needs for PBMG’s and the situation of play.
- Investigate appropriate media for wayfinding.
- Compare a ludic and story-based version of a PBMG to see which was preferred. and would meet the aims of the project more precisely.
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- Discover which graphical themes were acceptable to avoid putting children off at the visceral stage of response.

The sequence of events was as follows:

Preferred stories, objects & graphical themes
i) A modified Character and Story (CAS) method, conceiving characters, choosing a story and designing objects for characters to interact with.
ii) Choosing graphical styles & MORFO activity.

Co-designing a basic game.
A sequence of activities was carried out with pupils of Fairlight Primary to create their own versions of LBMG’s.
iii) Playing prototype game prepared for them.
iv) Photography in natural environments.
v) CAS activity for their game.
vi) Creating game MORFO & ARIS.
i) Playing prototype game prepared for them.
vii) Creating games in MORFO & ARIS.
viii) Playing their own games.

The relation of the methods to the Say, Do, Make (Think) framework is shown in Figure 4-23.
Figure 4-23 Say, Do, Make (Think) overview Phase 3
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4.4.1.1 Research Issues and Experience Map

The specific research issues addressed during this phase are given below in Table 4-6 including those that continue from Phase 2. The issues emerging during Phase 2 have also been included.

Table 4-6 Issues during Phase 3

<table>
<thead>
<tr>
<th>Contextual Dimension</th>
<th>Experience Category</th>
<th>Issue</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General and Pragmatic Concerns</strong></td>
<td></td>
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<tr>
<td>IC1 What are the best ways to safeguard children for PBMG play and promote feelings of safety for children and their parents?</td>
<td>Reflective</td>
<td>IC 1.1 How can children be safeguarded from real hazards and the information conveyed?</td>
</tr>
<tr>
<td>Player/R. Environment</td>
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<td></td>
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<tr>
<td>IC1.1 How can children be safeguarded from real hazards and the information conveyed?</td>
<td>Reflective</td>
<td>IC 1.2 What are children afraid of and how can it be overcome?</td>
</tr>
<tr>
<td>Player/R Environment/Behavioural</td>
<td></td>
<td></td>
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<tr>
<td>IC 1.2 What are children afraid of and how can it be overcome?</td>
<td>Reflective</td>
<td>IC 2 What kind of activities and play types can be transferred to the game environment?</td>
</tr>
<tr>
<td>IG2. How do the pragmatic dimensions of Location and Time influence the experience?</td>
<td>Behavioural</td>
<td>IG2.1. How do distances in a particular location affect the experience of play?</td>
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<tr>
<td>Player/ R. Environment/V. Environment</td>
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<tr>
<td>IG2.1. How do distances in a particular location affect the experience of play?</td>
<td>Behavioural</td>
<td>IG2.2. What kind of duration should the game and activities be, for this context?</td>
</tr>
<tr>
<td>IG2.2. What kind of duration should the game and activities be, for this context?</td>
<td>Behavioural</td>
<td>IG2.3 Are the observed time constraints in Phase 1, for activities appropriate for a PBMG?</td>
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<tr>
<td>IG2.3 Are the observed time constraints in Phase 1, for activities appropriate for a PBMG?</td>
<td>Behavioural</td>
<td>IC2 What kind of activities and play types can be transferred to the game environment?</td>
</tr>
<tr>
<td>IG2.4 What kind of stories can be included in a treasure hunt PBMG to make an adventure game?</td>
<td>Behavioural</td>
<td></td>
</tr>
<tr>
<td>IR1 (Phase 1: DR10) (Including IC 14) What kind of characters, narratives are appropriate to the game?</td>
<td>Behavioural</td>
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<tr>
<td>IR1.3 Which characters are preferred by the audience for a PBMG?</td>
<td>Behavioural</td>
<td></td>
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<tr>
<td>IR1.4 What kind of stories can be included in a treasure hunt PBMG to make an adventure game?</td>
<td>Behavioural</td>
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<tr>
<td>Clear Goals</td>
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</tbody>
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<table>
<thead>
<tr>
<th>IT9</th>
<th>What kind of media should be used to communicate intermediate and overall game goals?</th>
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<tbody>
<tr>
<td>IT10</td>
<td>How should the overall game goals relate to intermediate game goals to improve understanding (and volition)?</td>
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<tr>
<td>Levels of Challenge: To reduce unnecessary challenge.</td>
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<tr>
<td>IC 9</td>
<td>What level of physical &amp; cognitive challenge is acceptable for tasks in the game?</td>
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<tr>
<td>Emotional Needs to overcome challenge.</td>
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<td>IT7.</td>
<td>How can we predict and address the emotional needs of the player to encourage them to overcome inherent challenges?</td>
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<td>IT7.1:</td>
<td>How can challenges promote feelings of competence and mastery?</td>
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<td>IT7.2.</td>
<td>How can a social dimension be safely added to an LBMG?</td>
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<tr>
<td>Control</td>
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<td>IT11.</td>
<td>How can feelings of 'control' be promoted through the game, e.g. allowing a sense of autonomy, volition and choice.</td>
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<tr>
<td>IC13.</td>
<td>How can the child’s need for independence (control) be allowed safely through the game?</td>
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<td>Concentration &amp; Balance of Attention.</td>
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<tr>
<td>IT2.</td>
<td>How can feedforward in the landscape and game create a balance of attention?</td>
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<td>R. Environment/ Activities</td>
<td>Visceral</td>
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<td>R. Environment/ Activities</td>
<td>Reflective</td>
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<tr>
<td>IT1</td>
<td>Which media types draw appropriate levels of attention to the screen?</td>
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<td></td>
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<tr>
<td>V. Environment/ Games</td>
<td>Visceral</td>
</tr>
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</table>
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| IT4. What kind of role does feedforward/affordance within the game play in communicating directions and desired actions? |
| IG7. What kind of wayfinding tools, including maps are appropriate for the audience? |
| Feedback |
| IT13. How can the game inform the player about what has been achieved? |
| IT14. What kind of reward systems are preferred to give positive or negative feedback? |
| Immersion & Consistency/ Conceptual models |
| IT5. How can the narrative provide meaningful connections in the mind of the player between the characters, activities and game goals? |
| IT16. How can presence be maintained in the game, particularly when focus shifts between worlds. |

4.4.2 Procedure: 3 i) & ii) preferred stories & graphical themes

Two workshops were conducted at St. Andrews school, in Hove, over two separate events, with a group of twenty-eight pupils aged between 9 and 10. The events proceeded as follows:

i) Using an adapted version of the CAS method, pupils were asked to choose from a series of stories and design ‘collectables’ for use within the game.

ii) Graphical themes and content for a game were created using MORFO.

The specific objectives of these activities were to:

- Check previous findings about preferred stories.
- Investigate further their preferences for natural objects to add to the game content.
- Identify graphical themes that would be appropriate and not put children off the game.
- Further evaluate key emotional needs during the processes.

The pupils were initially asked to choose from a series of storylines that had been created by combining the most popular themes from the previous workshops in
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Phase 2 (created by both St Andrews and Fairlight children). The session also revisited some of the issues previously explored in CAS activity Phase 2. The order of stories presented to children was arranged differently across scripts in case it influenced choices. All of the stories include an element of choice, addressing the emotional need for control or ‘autonomy’ as defined by Rigby and Ryan, because of its previously recognised importance.

Story options were:

1. **Build a new Home:**
   ‘Your friend has had their house destroyed by a baddie and just escaped in time. What natural objects would you use to create a new protective home for them?’ (Also based on emotional needs for relatedness and competence)

2. **Get Superpowers:**
   ‘A baddie is trying to take over the forest and you need to get superpowers to defeat them. What natural objects could your character eat and what superpower do they give them?’ (Also based on emotional need for power (autonomy)

3. **Kidnapped friend, track the bad guy**
   ‘Your friend has been kidnapped by a baddie and you need to track them and find signs in the wood to catch them. What signs could you follow, e.g. flattened bushes, mole hills, tracks or poo’. (Also based on emotional need for relatedness and competence; does not require creativity)

4. **Curing a friend, through magic**
   A wizard can make a magic potion to cure your animal friend. What natural objects would you choose to put into the potion?’ (Also based on emotional need for power and relatedness)

5. **Art from Nature**
   ‘You want to make a work of art of a sculpture to take to a friend’s party as a present; what might you make it from.’ (Also based on competence needs)

The children were subsequently asked to choose objects from nature that might form collectable items for the game goals. Provided with books, digital resources and a series of images of natural things to choose from, they were asked create
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a simple sequence of game activity on paper, using the activity sheet shown in Appendix item, 8.6.1.

4.4.3 Results: choosing stories and collectables 3 i)

Ten pupils chose Story 4 (curing a friend through magic), with an array of natural fruits and flowers, also including the addition of creatures such as worms or slugs. Nine pupils chose Story 2 (get superpowers), with an array of similar natural objects, but some imaginative consequences of picking them up as collectables in the game, such as achieving slime power, from a slug, to slip away from enemies. One of the pupils drew a series of items they would like with them in their game ‘inventory’. Though this was not requested, there were some informative entries, including a shield for protection, an invisibility cloak to hide from enemies, a phone to get in touch with people and bedding for comfort, shown in Figure 4-24. Six pupils chose Story 1 (build a new home), with mostly trees or plants, though one child included ‘bamboo’, not a native of the UK. Stories 3 and 5 were not chosen and three of the scripts were not legible.

Figure 4-24 Objects desired for a game inventory.
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4.4.4 Discussion: choosing stories and collectables 3 i)

The results of the objects chosen for the games/stories is provided in Appendix, item 8.6.2. The exercise to choose from a restricted set of stories, rather than inventing their own from scratch, allowed further evidence to be found about their preferences and emotional needs. The aim was to choose a story that will not put children off and therefore inhibit a flow state and also to find out more about emotional needs. This helps when considering a further research issue, IR1.4 What kind of stories can be included in a treasure hunt PBMG to make an adventure game?

One of the stories about overcoming a ‘baddie’ by tracking and capturing them was not chosen, which was unexpected, because overcoming an adversary and ‘winning’ has been noted in previous findings and by Ryan and Rigby as a powerful driver for play (Rigby & Ryan, 2011). However, the other story (2) that had a similar theme to overcome a baddie was very popular. A key difference between the two is that the popular choice involved the player getting ‘superpowers’ to make them stronger against their assailant. The other two stories chosen had nurturing themes (provoking “naches”), including healing a sick rabbit or building a home for a friend.

The three themes chosen all had some feature of the game play that made the character less vulnerable, either through extra powers, a protective home, or magical healing properties. The idea was raised in Phase 2 that the children’s need to feel safe and protected in the natural environment could be supported through the game narrative. The study is not sufficiently quantitative to reach a conclusion, but in theory such narratives could address the issue: IC 1.2 What are children afraid of and how can it be overcome? In each case, the player was able to demonstrate mastery in obtaining the means to gain more status or power. This also contributes to answering the question IT7.1: How can challenges promote feelings of competence and mastery?

Findings in Phase 2, where benign animal characters can be presented as friends to emphasise a connection with the natural environment and make the child feel
supported within it, were also echoed in this exercise. This was proposed as a safer, virtual way to support the issue: **IT7.2. How can a social dimension be safely added to an LBMG?** Scarier creatures can also be presented as friends, or as an enemy, where they are overcome as part of the game narrative. Similar animal choices were made to Phase 2, supporting the findings for: **IR1.3 Which characters are preferred by the audience for a PBMG?** The extra ‘collectables’, included in the inventory by one child also involved transferring the comforts of home to the environment. This may also be an alternative way to feel more ‘at home’ in an otherwise less familiar environment.

Allowing various objects that the player can choose to collect is also an appropriate way to include an element of control within the game, in response to the issue: **IT11. How can feelings of ‘control’ be promoted through the game, e.g. allowing a sense of autonomy, volition and choice.**

Although not a large enough study to provide statistical evidence, because findings were similar to the previous phase, it can be tentatively suggested that game narratives, where natural characters and objects help to provide support, protection and increased power can help to meet key emotional needs. The points raised during this exercise helped through different also to consider the broader issue: **IT7. How can we predict and address the emotional needs of the player to encourage them to overcome inherent challenges?**

### 4.4.5 Procedure: graphical themes & MORFO 3 ii)

The session investigated the preferred look and feel for characters, an issue that arose in Phase 2. The pupils were asked to choose from a set of character styles; an example is shown in Figure 4-25. Subsequently they used the images to create their own animations as content for their conceptual PBMG using MORFO. The aim was not to discover what the ‘ideal’ style was, but to rule out appearances that might be off-putting, so that the research could later focus on how other elements of the game were received.

- Pupils worked from the story chosen in the previous session. The worksheet is provided in Appendix, item 8.6.4.
• The pupils were presented with a sheet of 20 different character styles (the full set of images for one animal is given in Appendix, item 8.6.5), based on popular creatures and also provided with books and Apps to find their own, if they didn’t like them.

![Character Design Options]

Figure 4-25 Examples of Character Design Options

• Children were asked to choose their favourite character style for four different animals and asked what they liked about it.
• Then they were provided with the template shown in Figure 4-26, to illustrate a simple game sequence.
• The children used their chosen characters to make a series of four animations with MORFO for the points illustrated in the game sequence.
• The first animation should describe the overall game goal and subsequent animations instruct the player about intermediate game goals. The final animation should congratulate the player when the game goals are achieved.
4.4.6 Results: graphical themes & MORFO 3 ii)

The cartoons that appeared ‘childish’, according to the pupil’s descriptions were not chosen and are therefore to be avoided in further phases. One of the preferred styles had a cartoon like appearance with bold contrasting outlines illustrated by the three images to the left in Figure 4-27 (chosen 8 times). The other popular style had a more photographic and realistic appearance (chosen 7 times). Other styles were chosen once, or not at all. Discussion 3 ii)

For the final game development, a more realistic style would be more representative of real animals, for learning purposes; it would also be easier to implement due to the accessibility of royalty free images and appears to be an acceptable style that does not put children off, whereas the cartoon version is
open to interpretation and harder to create. Real animal animations will therefore be used for future concept games in answer to the issue: **IT1.4 What media types draw attention to the game concept?**

### 4.4.7 Key Findings: choosing preferred themes 3 i) & ii)

- The children chose the storylines involving elements that could be used to support the children, through increased power, protection or healing properties. This reinforces the suggestion made earlier that children feel the need to be supported in this environment. It may indicate ways to overcome the associated fears that children have, as noted in the literature review in Chapter 2.2.
- Using nature to make the player more powerful could also help to connect them with nature, emphasising its positive qualities.
- Character designs that were close to reality or strongly outlined bold cartoons were preferred, along with more realistic images. The realistic images are easier to work with and as they are also acceptable, were chosen to work with in concept games.

### 4.4.8 Game design workshops 3

An activity similar to the design workshop in Phase 2 (ii onwards) was held with children from Fairlight Primary in June 2014. The sessions were organised differently from the previous year, as a series of half day workshops during a 6-week period. There were 12 pupils from Fairlight Primary aged 10-11 (a different group from the previous year) and three of their teachers. Another change to timing was moving stage v) to after the outdoor photography session to see if it provided the children with more opportunity to think about their game before designing the characters and narrative. The season was the same as in Phase 2, to ensure that similar seasonal natural features were present.

**The sequence of events was as follows:**

iii) **Game Testing**: Guidelines emerging from Phase 3 were tested through a ‘ludic’ style prototype game that I developed and presented to the children in Stanmer Park, Brighton.

iv) **Photography** exercise, to choose subjects in areas of Stanmer Park.
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v) **Character and Story (CAS)** paperbased exercise to create characters for the game and a game idea.

vi) **Co-Design of Location Based Treasure Hunt Game** with MORFO and ARIS to create media for their own treasure hunt games and place them at locations in Stanmer Park.

vii) **Game Testing**: Guidelines emerging from Phase 3 were also tested through a ‘story based’ prototype game that I developed and presented to the children in Stanmer Park, Brighton.

viii) **CAS** paper based exercise to create a storyline for their own game with the same characters previously created.

ix) **Co-Design of Location Based Adventure Game** with MORFO and ARIS activities to create media for their own story based games and place them at locations in Stanmer Park.

4.4.8.1 Ethics

The activity was carried out with Fairlight Primary School and Sussex Wildlife Trust, in a setting that they normally operate from within Stanmer Park. Normal protocols for permissions for their outreach to schools were followed to allow children to engage in the activities and also to ensure their security. Children could stop partaking in any of the activities at any time. Extra permission slips to permit photography and record voices were offered and all were signed. These were the same as in Phase 2, in Appendix item 8.5.1 to 8.5.3.

4.4.9 Procedure: AB game testing 3 (iii)

What were the activities? The testing of two conceptual prototype games took place in Stanmer Park, as before in Phase 2, with an emphasis on testing different attributes. The objectives were to:

- Cross-check previous findings about pragmatic guidelines, such as duration, activities, distances and nature preferences.

- Consider the best game genre to maintain engagement through the narrative.

- Consider preferred media and methods for wayfinding.
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Playing the games served to introduce the children to the idea of PBMG’s and what they would be creating. The games can be summarised as:

1. Ludic style game (Treasure Hunt genre), where players’ reward was a golden natural object after successfully completing each mission. When they collected all the golden objects they became a nature warrior.

2. Story based game, (Adventure genre) In this case, the reward was a character that appeared at the end to thank the player for saving them.

The children played the games on consecutive days during the workshops, so that they would not be tired or bored with the format. The weather was similar on both occasions. Preferences were checked with the children through a subsequent questionnaire. As before, during the testing, one child in each group of three was responsible for videoing their journey and this allowed the recording of their voices. The devices were circulated around the group at intervals. Notes were also taken after every observation.

Pragmatic dimensions explored in the previous phase had established a playable format in terms of physical and cognitive ability and were included as follows:

- Both games were constrained to distances of 30m between points, in similar locations to the previous year.
- 90 minutes was an intended overall duration, though games could be completed sooner or with more time. 15 to 30 minutes was reckoned for the intermediate game activities.
- A linear sequence was used.
- The sensitivity for finding a GPS location was set to within 5m.
- An animated character introduced the instructions at the beginning for both games, including general safety information, protocols in the natural world and spoken directions about how to get to the next location. The children had to watch this to proceed.

Identified preferences from previous phases were also included:

- Each game included similar intermediate game goal activities to the previous tests over a range of play types.
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- Animated characters offered instructions and directions throughout.
- Characters that children had previously chosen were included.
- Locations that had drawn the child’s attention during the photography exercise in Phase 2 were used as GPS points for activities.
- Both games had characters within them; the difference was in the addition of a story that guided the game.
- Both games had feedback about success on completing the game goals, represented in different ways.

To further investigate wayfinding solutions:
- **Map Icons**: following on from conclusions in Phase 2, the map for both games was set on ‘terrain’ and included image icons on the map to represent locations. The image helped to indicate what the player needed to find at their destination and a text title helped to avoid ambiguity about what the image was.
- Though a linear sequence of locations was being adopted, it was not considered necessary to number the points, because each location held information about where to go next and supplying numbers would defeat the game goals, making it impossible to assess the effectiveness of the different media, in this case to direct players.

![Figure 4-28 Recreation of Map Icons with Images and Text](image)

The following describes activities or media at the locations:
- The first location for both games included an animated character, with audio. This introduced the game and what players had to do, codes of
behavior in the country and included warnings about animals and other hazards, besides how to find the second location.

- At the second location, for both games the player was showed an image of where they had to travel next, alongside a text description of how to get there. This was designed to further evaluate their media preferences and their ability to interpret different types of media.

**Other Locations for Game 1 (ludic game, treasure hunt genre)**

The following activities were presented in succession

1. Animated owl character: ‘Look behind you in the field, wait to see one of the birds swooping and catching insects, what do you think they are?’ (Quiz with multichoice answer rewarded with virtual gold).
2. ‘Find a dock leaf, which can cure a nettle sting, using the picture’ (collect the gold reward), (exploratory play).
3. ‘Look around the dead tree, this is a great home for insects, find 2 mini-beasts and photograph’ (collect the gold) (exploratory play).
4. (In the woods), ‘listen, and record some bird song’ (collect the gold) (sensory play).
5. ‘Make a den using branches and leaves, but only those found on the ground’ (deep play).
6. Final Point: Animated character: ‘well done on completing the game and gathering the gold, see you next time’.

**Locations for Game 2 (Adventure Game style with story base)**

This version included similar activities but had a story wrapped around the game goals: ‘An evil wizard has captured some of your animal friends, you need to collect some natural things to give you magic powers to defeat him’.

1. ‘Find some deadly berries that will give you the power to poison your enemy’ (Exploratory Play).
2. ‘Find some rabbit poo, to give you super stink power and overcome the enemy’ (Exploratory Play).
3. Have a conversation with a virtual lady bird, to tell you where to find things (Social Play) Then further video instructions to next point.
4. ‘Find a dandelion and blow on it, to give you flying powers’ (with an image) (Sensory Play).
5. ‘Find a slimy snail and touch it to give you slime power, then you can slip away from your enemy’ (Sensory Play).
6. When all of the items have been ‘gathered’ or activities performed, the freed animal characters appear and express their gratitude.

In a more sophisticated game version each of these items might be a prompt for a particular encounter with the wizard. However the format needed to be as similar as possible to the treasure hunt model and also represent something the children could make themselves in the subsequent stages.

4.4.10 Results: AB game testing 3 iii)

Pragmatic guidelines:
Pragmatic dimensions proposed in Phase 2 were reinforced during this evaluation, suggesting they are useful guidelines. These issues are final proof that the following issues are resolved: IG2.1. How do distances in a particular location affect the experience of play? IG2.2. What kind of duration should the game and activities be, for this context? IG2.3 Are the observed time constraints in Phase 1, for activities appropriate for a PBMG? It was also noted that setting the sensitivity for discovering points, allowing children a 'hot-zone' of around 5m was also suitable to avoid difficulties in finding a precise spot; the latter providing further information towards: IC 9 What level of physical & cognitive challenge is acceptable for tasks in the game?

Game Genre
The questionnaire filled in by the children after playing the two games revealed that most did not have a preference between the two game genres. Most said they liked both, with only two preferring the story-based version and one the treasure hunt version. The results cannot provide statistical proof, but suggest that either variation can be acceptable in answer to the issue: IT5. How can the narrative provide meaningful connections in the mind of the player between the characters, activities and game goals?
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Activity instructions
The animated character with audio was understood by all pupils in describing the activity to be performed at each location, confirming the answer to issue: **IT9 What kind of media should be used to communicate intermediate and overall game goals?**

Wayfinding
It was observed that adding an image icon on the map required the child to look for features in the landscape and took their attention away from the device when they were arriving at a location (the alternative previously was to watch a dot moving on screen). This has helped towards the issue: **IG7. What kind of wayfinding tools, including maps are appropriate for the audience?** The game had used some of the locations chosen previously by children. In practice, used with the image icons, the locations preferred by children were easier to find than those in previous trials during Phase 2; these points were intended to address the issues: **IT2. How can feedforward in the landscape create a balance of attention? IT2.1 Which features of the landscape draw the player’s attention (have more visibility)? IT2.2 Which features of the landscape are meaningful to the child raising awareness of it (& have added affordance)?**

Providing initial information about which direction to set off in for the next location was effective, compared with no information in Phase 2 trials, considering: **IT4. What kind of role can feedforward/affordance within the game play in communicating directions, and desired actions (for wayfinding)?** These instructions also helped to avoid problems with GPS delay in giving feedback. However, the children usually had to replay the animation to check what was said (and in some cases, it seemed from their remarks, because they just enjoyed watching it). This is providing more proof towards: **IT1 Which media types draw appropriate levels of attention to the screen?**
4.4.11 Implications for design research

4.4.11.1 Levels of challenge:

- Previous pragmatic dimensions were confirmed during this testing process, as being supportive of appropriate levels of physical and cognitive challenge.
- The set of activities presented during this phase were also all understood by the children and they were able to carry them out.
- The terrain map made it easier for players to identify their location. Other challenges presented by wayfinding and GPS are discussed further under ‘concentration’.

4.4.11.2 Game goals

- An animated character was confirmed as being a useful way to communicate the overall game goals both at the beginning and also during intermediate activities at relevant locations. This was noted as likely for this stage of the child’s development and the media provides a consistent form of delivering instructions throughout. The use of different media represents using different signifiers and relates to the concept of feedforward.
- The two different game types represented different ways of connecting the intermediate game goals to the overall game goal, one being via a story and the other via an activity-based game, with intermediate activities that add up to the whole. They represent different conceptual models for connecting the meaning of the different elements of the game. Both games have a narrative, the ludic version to collect golden objects to become a nature warrior, the latter based on a story, but with a different relationship to the game play. A narrative is suggested as being important for connecting meaning in the mind of the player by Ritchie (Ritchie, 2014). As there was no overall preference it is not possible to reach a conclusion about which was preferred but noting that the narrative was effective for both and connected the tasks requested of the player into a gestalt.
4.4.11.3 Concentration and balance of attention

- Image icons included on the map with a simple title were instrumental in supporting wayfinding and a balance of attention. They encouraged the player to look away from the screen in order to identify particular phenomena for the next location, promoting concentration on the landscape.

- Initial instructions to provide directions through an animated character were found preferable to text in Phase 2. However, in this phase, they were only found partially successful as a way to avoid screen time. Head down interaction was still notable and frustrations with GPS still present. More research is therefore required to further investigate these points.

- Locations within the games were based on areas where affordances in the landscape or visually striking features were likely to draw the attention of a player. This also helped to balance attention towards the landscape, using the technique of feedforward to engage them with the natural environment.

4.4.11.4 Control

- Exploration was still possible within the game constraints i.e. setting points 30m apart, helping to meet autonomy goals. Activities were also included that encouraged exploratory behavior for similar reasons. Exploration is related to autonomy needs and related to control.

- The story-based game was more likely to appeal to players who like to have a strong sense of volition within the game, according to Rigby and Ryan (Rigby and Ryan, 2011) and Freeman (Freeman, 2003). A sense of volition is synonymous with a feeling of control.

- The ludic game is more likely to appeal to competence needs, as the activities are connected with a sense of achievement (Rigby and Ryan, 2011).

- Both games had a narrative, suggesting that, to varying extents, the player was engaged in a fantasy world when completing the game goals. Fantasy worlds allow escapism, according to Del Vechio, where the player can have more power than in the real world. Feelings of power have also been
related to feeling in control by Rigby and Ryan (2011). This effect was likely to be greater for the story-based game, according to some theorists (Freeman, 2003, Ritchie, 2014).

4.4.11.5 Feedback

- In the case of the two game types, different rewards were offered. In the ludic game, virtual gold was given to the player on completion of a task, while in the story-based game, the reward was positive feedback from a character. Both were indications of achievement, however the first is likely to support competence needs and a sense of achievement, while the feedback reward is associated with a sense of completing an important mission and also positive interaction with other characters (relatedness).
- Feedback was again noted to be an aspect of fulfilling a range of other flow pre-requisites.

4.4.11.6 Immersion

- The activities drawn from the holiday clubs with SWT, other experts and relevant literature were again seen to engage the child in the landscape through physical and visceral immersion.
- Including the children’s preferences for characters will also be more likely to increase engagement and this is a form of visceral response, relating to immersion.
- The preference for ludic or story-based games was inconclusive, but it was confirmed that both were acceptable. It was identified by Ritchie and Rigby and Ryan that a strong narrative, more obvious in a story-based game, can improve immersion and it is also the case that a nature-based story can immerse children in natural phenomena. The adventure game genre is therefore the genre of choice to fulfill the project aims.

4.4.12 Procedure: photography 3 iv)

The children took photographs of their preferred subjects at Stanmer Park, in their groups of three, similarly to the previous phase. They shared an I-pad and two waterproof cameras and their images were recorded and GPS tagged. However,
in this case, for simplicity, the children were directed to certain locations that had been chosen by the previous year group. This also avoided points being accidentally located in unobtainable areas. The children were, however, encouraged to wander within 30 m and find their own subjects.

4.4.13 Results: photography 3 iv)

The full results of the photography are shown in appendix item 8.8.8. However, an excerpt is shown below, demonstrating that results of what children find of interest showed similarities to the previous year.

<table>
<thead>
<tr>
<th>Table 4-7 Children’s Photographs of Locations</th>
</tr>
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<tbody>
<tr>
<td>a) One group featured insects inside buttercups. Looking for them was later turned into an PBMG activity. There were also ten different flower pictures of different species.</td>
</tr>
<tr>
<td><img src="image1.png" alt="Image of insects inside buttercups" /></td>
</tr>
<tr>
<td>b) Signs of animal activity were featured, with photographs of holes they lived in and mole hills repeated for this session.</td>
</tr>
<tr>
<td><img src="image2.png" alt="Image of animal signs" /></td>
</tr>
<tr>
<td>c) This shot of ‘King Alfred’s cakes’ was taken by one of the children. The name suggested an interesting narrative behind it.</td>
</tr>
<tr>
<td><img src="image3.png" alt="Image of ‘King Alfred’s cakes’" /></td>
</tr>
</tbody>
</table>

4.4.14 Discussion: photography 3 iv)

The categories that the subjects chosen by the children fell into were often similar to those of the previous year, when we worked with a group of different children. Animal signs and insects, in particular, were popular again. Colourful objects, such as flowers and areas of strong contrast were again chosen, and areas of light and shade, suggesting their properties made them stand out viscerally, as discussed by Norman (2005). Signs of natural activity were once again picked out
and signs of new growth or reproduction, representing new life, as well as dead trees, representing ‘end of life’. Trees that afforded climbing were also featured, in line with Fjortoft’s interpretation that these would be meaningful and therefore important because they afford a desired activity. One small tree was given the label of ‘baby’ as a term of endearment, perhaps demonstrating anthropomorphism. Symbolic associations were also made, with interpretations of a root system as a ‘cave’. Children were also particularly interested where there was a related narrative for a subject, e.g. the King Alfred’s cakes fungi. The children also seem to pick out objects that they are knowledgeable about, e.g. dock leaves. There was a cautionary element to the data, when a child chose a poisonous plant, assuming it was elderflower. Children are warned not to eat anything, but examples such as these could be indicated through the game to provide specific cases.

4.4.15   **Key Points: photography (iv)**

- The results backed up previous findings. Chosen sites repeated subject types that fell into the category of theoretical ideas about ‘feedforward’ with a range of signifier types. This included areas that had special symbolic meanings, iconic or metaphorical signifiers and index signifiers, along with areas that had increased visual weight, including contrasting colours or forms with surroundings.
- Children were interested in themes where they could display their knowledge.
- Children were interested in the life cycle of the natural objects they encountered, new growth or dying subjects.

4.4.16   **Procedure: CAS 3 v)**

Two different CAS activities were carried out at this stage. In the first version, pupils were asked to create a lead character for a ‘treasure hunt’ style game. Initially they were asked to come up with a game mechanic, rather than a story, e.g. what would be collected or where would be visited and why. In the second CAS activity, aimed at an adventure game, they were asked to choose from suggested stories, in the same way as the previous group in 3 i) but they were...
4.4.17 Results: CAS 3 v) During Phase 3, the activities were actually carried out in a less sequential fashion than had been intended, with pupils going back and forth between creating characters and stories, animating their subjects as requested in MORFO and adding to the game. Therefore, the results of this stage will be discussed alongside the results of the co-designing procedure to create their game, discussed next.

4.4.18 Procedure: co-design with MORFO & ARIS 3 vi) Similar co-design activities were performed as for the previous year, using the same digital tools. The difference was that this time the children were asked to make two game versions. Firstly, they created a treasure hunt, with objects to collect or places to visit, similar to the one they had tested earlier. They subsequently played their game to see any issues that had arisen with it. Then they created a different version of the game, an adventure game, with a story and characters added. The template, to help with this, was the same as that given to the St Andrews Children, shown in Figure 4.-26.

4.4.19 Results: co-design with MORFO and ARIS 3 vi) All groups were able to create the two versions of the game required in basic form. However, when creating the ‘treasure hunt’, ludic type game, instead of just designing a game mechanic, the children were keen to come up with a narrative and story around their game from the start. They then continued to develop the concept, adding more characters, through a series of MORFO videos to tell their tale. In practice, therefore, the narrative in the game didn’t change in the second game created, but the adventure version simply had further characters and activities added.

Although suggestions for stories were offered to the children, as before in 3 i), two of the groups created their own variation. Those chosen, or created, for the story-based game again included resources from the environment to add power or
protection, one to make a magic potion, another to create weapons to attack an opponent and another that included some ‘deep play’ activities based on a narrative about survival in the wild. The main characters of all games and associated story for this activity are given in Appendix item 8.6. A sample of this activity is shown below, representing a ludic style game, with associated narrative, and a story-based game, in Table 4-8. The results of all story activities are given in Appendix item 8.6.3.

<table>
<thead>
<tr>
<th>Main character</th>
<th>Treasure Hunt ludic game mechanic</th>
<th>Adventure (story based) game narrative.</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.jpg" alt="Tree with eyes" /></td>
<td>An evil tree needs gold (which the player collects)</td>
<td>Each time the player gets gold, the tree will free one of their animal friends it has captured.</td>
</tr>
<tr>
<td><img src="image2.jpg" alt="Wizard face" /></td>
<td>An evil wizard has captured animals inside the trees and to release them the player has to visit locations and do tasks.</td>
<td>They collect ingredients for a magic potion to overcome the wizard and save their friends.</td>
</tr>
</tbody>
</table>

**4.4.20 Discussion: CAS 3 v) & co-design PBMGs 3 vi)**

Some of the subject matter chosen for the children’s games showed that they were paying attention to the environment (e.g. finding insects in flowers) and the game content during the AB testing (e.g. including the tree, dock leaves and nettles in their own game version). The latter could also reinforce the idea that children like to display their knowledge and ‘mastery’ of natural subjects.

When selecting a given story and making their own narrative, again examples were seen of finding things around them in the game to give them more power. In some cases, they were natural objects, as in the magic potion, in others virtual
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weapons. These features have been noted through all of the CAS activities in Phase 2 and 3 and strengthens the argument that children like to feel empowered and this may be a useful way to allay fears in this environment. The addition of friendly, supportive characters also appears once again in the games, either as allies or animals to be rescued, seen throughout the CAS activities in all phases.

4.4.21 Key Points: CAS 3 v) & co-design PBMG’s 3 vi)

- Children were keen to add a story to their work and the narrative behind the game they were creating was important to them.
- Similar natural themes were chosen for their games to ones shown to them, suggesting they had learned from the prototypes they had played about aspects of the environment and perhaps enjoyed displaying their knowledge of the subject.
- Similar themes, such as friends and natural objects that gave them power or protection came up in stories, validating previous findings.

4.4.22 Conclusions for flow phase 3

4.4.22.1 Levels of challenge

Levels of physical and cognitive challenge are influenced by the pragmatic dimensions of the game, including the overall duration, timing for the intermediate game tasks, distance of travel and sensitivity settings for the game. These dimensions were evaluated again during this phase, during AB testing and found to be acceptable and therefore unlikely to inhibit flow.

Activities at each location, which were similar to Phase 2 but with different content (forming the intermediate goals), were investigated during AB testing and observations showed that they presented appropriate levels of physical and mental challenge. The activities chosen had been inspired by those carried out by nature experts (SWT) during observations in Phase 1, and also from the literature review. The criteria applied for their selection for the PBMG, i.e. they can be understood without a guide, do not present obvious dangers and address different play types and different emotional needs provided suitable guidance for their
selection. The examples provide various possibilities for adaption to different subject matter and, presented within a PBMG, will support a flow state.

Wayfinding was found to be one of the more challenging aspects influencing playability; this can be one of the more difficult, repetitive and potentially dull elements of the game. Problems can occur through GPS lag at various stages of navigation: indicating position on the map, providing orientation when moving towards a location and awareness of locations upon arrival. Possible mechanisms to reduce the effort involved were only partially successful and therefore need further investigation in the final phase.

Relatedness is also discussed by the PENS group (Rigby & Ryan, 2011) and considered to be the third main key emotional need. Being connected to friends and mutual support has arisen frequently through the story investigations, suggesting its importance to children. Where it is not safe to promote contact with real people through the game, the potential to have friendly supportive characters in the game may help to compensate. This technique may also serve to connect the child more with natural concepts: exploiting their love of animals, for example. The child’s predisposition to nature can also be considered a ‘relational’ emotional response if Norman’s (2012) reflective response is compared. These attitudinal factors relate to the child’s previous relationships and experience and could be considered as a will to be connected, either to people, objects or places.

4.4.22.2 Clear overall and intermediate goals

The animated audio tracks proved to communicate the required activities adequately, supporting findings in Phase 2. The intermediate goals are therefore clearly expressed through this format and further experimentation is not required, as a flow state is adequately supported.

The clarity of the relationship between the intermediate game goals and the overall game goal was explored through the two game types, in AB testing and co-designing with the children. In one case, a story created the link between activities (adventure game type), while in the other, the connecting goal was to collect as much gold as possible through each activity (ludic game time). No
preference was indicated between the types, but it was evident that the story-based game design has more potential to link the overall goals to learning about the environment and more flexibility both to address different emotional needs and to increase volition towards the game goals. In the final phase, therefore the story-based alternative will be further explored.

4.4.22.3 Control

There was evidence through the story selection and game co-design process to further support the findings in Phase 2, that the child had a desire to feel in control over proceedings and this could be manifested through a need to establish their autonomy during the game or to feel and demonstrate competence. For example, during the story selection exercise, a version chosen several times allowed the player to overcome an adversary by gaining super-powers, another that was not chosen had similar themes of beating an adversary but without any extra power. Feeling powerful is a key competence need. Feelings of control can also depend on having an impact in the game, for example, ‘saving’ other animals or the natural world. Another of the stories that was not chosen suggested an abstract creative activity with no connected sense of purpose to the task. While this is not quantitative data, when put together with evidence in Phase 2, the conclusion was validated that control needs formed a large part of the child’s motivation and engagement towards the PBMG. This could be considered triangulated from a range of different data sources and the stories suggested provide a useful selection of techniques for addressing these needs. A summary of stories gathered through Phases 2 and 3 and how they may meet players’ emotional needs is given in Table 5-4, in the chapter 5, in the analysis of these results.

It was also noted in this phase that autonomy needs, through exploration, can still be addressed through the PBMG by allowing players to wander within a constrained 30 m area, and also encouraged through including exploratory play as intermediate game goals. The opportunity to choose from different natural objects as ‘collectables’ was also a potential way to provide autonomy.
4.4.22.4 Concentration (Attention)

From evidence gathered during this phase, careful choice of media to give wayfinding directions can help to reduce the cognitive load associated with screen-based clues; this applied to both map-based static images, which helped to provide visual information about a site and animated audio tracks, which describe the direction to be taken. Similarly, using striking or meaningful features as locations was noted as helpful to provide landmarks for directions. These findings were also considered validated in this phase.

4.4.22.5 Feedback

Feedback has been considered through specific research issues. Situations where feedback can be helpful during the game, include supporting wayfinding, arrival at a location, completing an intermediate game goal or finishing the overall goal of the game.

When wayfinding, slow feedback about position through the GPS signal had been shown to impact on the flow of the game. Solutions including animations to describe initial directions were only partly helpful and alternative solutions need to be found. When the player arrives at a destination, they receive useful feedback that the point is available from within ARIS through a sound and visible and are able to access the relevant media. The addition of an image icon of the target area helped to also provide visual feedback upon arrival. Feedback to acknowledge the success of finishing a task or the overall game was also provided through an animated character and helped to promote feelings of competence, always important for a game and to overcome levels of challenge.

4.4.22.6 Immersion

Meeting the guidelines for the previous pre-requisites should promote a sense of immersion in the game (flow state). PBMGs that have addressed previous pre-requisites should encourage the player through offering an appropriate level of challenge, promoting a sense of control, clearly defining and communicating goals and providing appropriate feedback about success. Activities presented in this phase, covering a range of play types including functional, physical, sensory and
exploratory play, will also encourage the player to interact with the environment using a range of senses. In this phase preferences for the look and feel of the game, through the character designs, were considered. Using preferred graphical styles for their design is likely to improve first impressions of the child, related to their visceral response and increase their immersion in the activity.

4.4.23 Emerging guidelines

Levels of Challenge
Previous pragmatic guidelines from Phase 2 were confirmed.

- Activities for intermediate challenges can be based on those used in non-digital play scenarios. The criteria for selection for a PBMG, should be that they can be understood without a guide, do not present obvious dangers and address different play types.

Clear Game Goals

- A narrative should be included, based on the natural environment, to link the intermediate game goals to the overall game goal.
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4.4.24 Emerging research issues

Control
(Previous control guidelines from Phase 2 were confirmed).

Where autonomy needs are emphasised:
- The game narrative should be story-based to increase a sense of volition and purpose.
- Create a sense of volition in the player, through themes such as gaining freedom for the player or other characters, saving the forest, saving animals or conducting another important mission.
- Allow the player to choose objects or characters as part of the gameplay.

Where competence needs are emphasised:
- The game narrative should be related to intermediate activities that offer immediate rewards for achievement, such as ‘collect the gold’ when a task is completed.

Immersion
- Use imagery and themes for the game characters that the audience can relate to and are appropriate to the developmental age (for older children, either bold cartoons as in the examples or realistic looking natural characters).
- Using realistic looking characters can increase knowledge and therefore a connection with natural subjects, related to immersion.
- Include narratives that allow the player to feel empowered or protected by natural subjects.

Which kind/s of media trigger promote immersion in both the real environment and the game?
What kind of media can improve the balance of attention when wayfinding?
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4.5 Design phase 4: physical and virtual worlds

In the previous phases, we established properties of a PBMG that relate to pragmatic concerns of playability and proposed design guidelines. Content and themes that can improve engagement were identified and a better understanding of emotional needs established. This now allows us in this phase to increase emphasis on the balance of attention across virtual and physical worlds and other aspects of immersion. Phase 4 involved a further study into media for wayfinding and investigations into different ways that the media can be activated (triggered). The superimposing of virtual content over a physical context (Augmented Reality or AR), through a more developed prototype, was also explored, giving three sets of activities:

i) Explorations with audio for wayfinding.

ii) Explorations with video sequences to illustrate the route for wayfinding.

iii) AR investigations through more developed prototypes.

The AR investigation was achieved with the help of a final year computing student at the University of Sussex, Xiangxiang Gong. The issues considered for this phase are listed in Table 4-9.

<table>
<thead>
<tr>
<th>Contextual Dimension</th>
<th>Experience Category</th>
<th>Issue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virtual Environment</td>
<td>Visceral</td>
<td>IDR3</td>
</tr>
<tr>
<td>Real Environment/</td>
<td>Visceral</td>
<td>IT2</td>
</tr>
<tr>
<td>Virtual Environment/</td>
<td>Relational</td>
<td>IT1</td>
</tr>
<tr>
<td>Activities</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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4.5.1 Procedure: audio investigations, phase 5 i)

In Phase 3, it was noted that initial directions provided by an audio track (presented through an animated character in the test) help to orient the player when leaving one location to find a subsequent point of interest. However, head down screen interaction was still required to look at the character (which drew the player’s attention) and to watch the GPS marker dot showing current position, drawing attention away from the physical world. To consider this, the problem of appropriate media was further investigated through a participatory workshop, with an immersive audio expert. A coastal habitat was used as the test area, by necessity of proximity, but represents comparable difficulties to grassy or woodland areas, when wayfinding, as it also has randomly repeated, similar features, with few distinctive landmarks, illustrated in Figure 4-29. In the exploration, directions to five different points were recorded and three adult participants took part in the test, it was anticipated to follow testing up with children in a following phase.

- **Objective:** To consider the effectiveness of an audio track in orienting players for wayfinding, when visual cues were eliminated.

![Figure 4-29: Terrain used for Audio Testing](image)
4.5.2 Results: audio investigations, phase 5 i)

The audio track was found to be an ineffective method to direct navigation in a natural environment. The participants found it difficult to become oriented at the start of their journey and subsequently when finding the location, using the audio description alone, in one case missing a location by around 10m.

4.5.3 Procedure: video investigations, phase 5 ii)

Earlier observations during Phases 2 and 3 had suggested that visual cues were helpful when locating a site, particularly including an image on the map or a previous point that showed a distinctive landmark to aim for. In this exploration, videos were presented at the start of a journey showing an initial route for a player to follow.

The videos were made by walking between the intended points, while recording the video. The footage was later assigned to GPS locations via a basic production using ARIS. The videos gave the impression of the first-person player moving off to the next point. Only the beginning of the journey was recorded for a few reasons. Firstly, a large video would take up too much memory, would not load easily and would have added delays to the game. Secondly, the game system gives good feedback of being within proximity of the destination and an image of the site or feature to aim for helps to encourage attention towards the landscape. The production did not include in-game activities as previous versions had, or other tasks to isolate the properties being investigate. Three different locations in Stanmer Park were included, in similar terrain to before. Three different videos were placed in three locations. The video routes were tested on four different young players.

4.5.4 Results: video investigations, phase 5 ii)

This method of directing the player worked well. Players were able to set off in a relatively precise direction, compared with using only a description and a map during AB tests in Phase 2 and 3 and compared with the audio media providing directions. Participants also had to keep raising their head to compare the video route with the real world, which helped to avoid head down interaction.
4.5.5 Key findings: phase 5 i) & ii)

- Use of audio alone, without visual cues, does not help to guide a player in natural terrain where there are few landmarks.
- A long video of an entire journey between points would take up too much memory, however, the game system gives good feedback to a player who is within proximity of the destination and an image of the site or feature to aim for helps to encourage attention towards the landscape.
- Adding visual cues through a video can help to orient the player so that they start their journey in the correct direction. This can avoid frustrations with slow GPS feedback and can be presented as if the lead game character is taking a certain route.
- The video also helps to avoid head down interaction.

4.5.6 Prototype with different media triggers phase 5 (iii)

1.1.1.1 Overview

In this final stage, a more finished prototype was developed by Xiangxiang Gong, to explore how virtual media appeared to the player and how this impacted on the experience. Virtual media objects were superimposed on the real world, via Augmented Reality (AR).

The objectives were to:

- Investigate how different media types influence the relationship between the real and virtual world.
- Establish which media are easier for children to activate.

4.5.7 Game design: media triggers phase 5 (iii)

The final prototype game appeared as a stand-alone APP on an iPhone. The basic parameters of the game followed some of the design guidelines previously established:

- Linear game sequence: In this case a line was drawn to provide a graphical representation between the locations to provide further guidance, shown in Figure 4-30 to support wayfinding and show the most direct route to find the GPS points of interest.
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Way finding within the App included a Google terrain style map, as before.

The distance, overall time spent on the game and activities were well within the maximum parameters that had been identified previously.

The terrain was at a lower level of physical challenge, in terms of undulation and accessibility so that the points were relatively simple to find and access, compared with previously tested games. This was so that the children could focus on comparing the trigger methods, without other factors potentially increasing physical and cognitive load. It also made the inclusion of video directions an unnecessary use of time.

The game tasks were reduced in terms of physical and cognitive effort, again to avoid skewing the findings by causing children to be fatigued.

The game included two different forms of ‘trigger’ to superimpose virtual content on top of the physical world. The different types were:

- GPS activated: media appeared automatically at a map co-ordinate and children had to orient themselves to find the animal that appeared. An example of how the character appears on screen is shown in Figure 4-28 to the left.
- Object trigger: a physical object, recognised by the software, such as the knot feature show on the tree, on the right in Figure 4-31, to trigger media.
- The game had a story associated with it. Their mission was to save forest creatures, captured by an evil wizard, which had been identified as an engaging plot in previous phases. At each location, a creature gave them a secret code letter. The final word had to be entered on a screen like the one
shown in figure 4-32. This would free the captured creatures. It rewarded them through a congratulatory message from a final character.

Figure 4-31: Different Media Triggers for Final Game

Figure 4-32: Screen shot of where children enter the final Secret Code

- The content of the game included 3D models created in 3Ds Max to represent the animals, which were semi-realistic (within the modelling capability of the student).
- The game was programmed in Unity (a well-known game engine) and Metaio used as an SDK for AR to develop the game.
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4.5.8 Procedure: media triggers phase 5 (iii)

There were two separate game evaluation sessions, with two groups of children, aged between 9 and 10 and three children per group as before (six children on each occasion). The only information provided was the approximate game area and participants were shown the App icon that they needed to activate. Their progress was observed by three researchers (one adult per pair of participants) and video recorded. The children gave their opinion via the feedback form, example provided in Appendix item 8.7.1.

4.5.9 Results: media triggers phase 5 (iii)

The children were able to find the locations, though issues with slow response of GPS were still evident. The addition of the line graphic on the map did not really influence the ability of the child to find a subsequent point; the GPS location on the map was found to be more of a significant influence in guiding the player. GPS location was the most reliable trigger; the children were all able to see the character that appeared, though one pupil had to be told to turn around to the correct direction. Using the ‘secret’ symbol represented by knots trees as a trigger was met with more excitement, in comments; it was as if nature was ‘revealing secrets’. However, in practice the triggers were quite hard to activate for most of the children and some were not able to do so at all without adult intervention. This was probably because the angle to activate the trigger was critical and it was hard to get this correct. The children were generally at a different height and the recognition cues were set up by an adult. The tree knot used as a trigger is illustrated in Figure 4-33 in the left picture. The children

Figure 4-33: Positions when activating object recognition triggers
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The addition of secret information to be uncovered in the environment proved to be an engaging narrative for the children, from observations and subsequent feedback.

4.5.10 Key findings and implications for design research:

media triggers phase 5 (iii)

- Using a GPS location was a more reliable trigger than attempting to perform object recognition on natural objects. This version provides more immediate feedback about successfully locating a GPS location.
- Further information (feedforward) is required to suggest the possible action of turning to view the character, through affordances and signifiers. This could take the form of an on-screen character or instruction to tell them to look around and explore as had been implemented and tested in previous games. As they are looking at the map at this point, this would seem a reasonable compromise.
- Using natural objects created more of a direct connection between the real and virtual world. The children made more connection between the natural object and what it represented in the game, e.g. a ‘secret sign’. This version therefore represented greater immersion, in the sense of feeling ‘present’ in the natural environment.

4.5.11 Conclusions for flow phase 4

Appropriate levels of challenge had been established in phases 2 and 3, along with a series of findings about children’s emotional needs for PBMGs for this context of play. In this phase, concentration, through a balance of attention and immersion was further considered through the use of media to link the real and virtual world for wayfinding and revealing the game goals. The prerequisite for feedback is also discussed. However, along with the concept of ‘feedforward’ introduced by Norman, these concepts have emerged as being part of the process of interaction, which facilitates other prerequisites to be realised.

1.1.1.2 Clear game goals

The use of the animated characters in 3D max was similar to the previously used MORFO characters and performed the function of communicating game goals in an agreeable way. The addition of a character on screen to suggest looking around when
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GPS was used as a trigger would have helped with observing the AR projection and replaced the human guide more appropriately. Ideally, this would have been implemented through a further prototype but was not possible within the time frame of the project. However, the on-screen characters had been successfully tested in earlier phases and it is assumed that the results would still be valid for this instruction.

1.1.1.3 Concentration: balance of attention and wayfinding

One of the key areas of focus during this phase was on ways of reducing head-down interaction with the screen in order to improve the balance of attention when wayfinding. Wayfinding is a relatively difficult task and is repeated throughout the game; this was seen to impact on concentration in previous phases and the experience of play. Use of audio alone would preclude any requirement to look at the screen; however, this was not an effective way to communicate directions within a natural environment. Using pre-recorded video that showed the route to be taken when setting off to the next destination was, however, very effective.

1.1.1.4 Immersion

Superimposing virtual media on top of a natural environment was very engaging for the children. This approach could be argued to bridge the perceptual gap between the real and virtual worlds and improve immersion. AR is very popular and contributes to the success of games such as Pokemon Go! In theory, the immersive effects are what makes it so appealing. However, a full investigation of the immersive properties of AR is beyond the scope of this project. Other methods of encouraging immersion have been discussed above. Using natural triggers, combined and use of the narrative related to nature also promotes immersion in the landscape, while A compelling narrative, related to the subject, can to improve immersion and hence, flow (Ritchie et al.2014).
4.5.12 Proposed guidelines: phase 4

- Videos showing a route can help with wayfinding
- Promote feelings of immersion by superimposing virtual media into the real world, using techniques such as AR.
- A narrative that includes nature as a subject promotes engagement with the subject.
- Use triggers for media using GPS location where reliability is required, providing the signal is strong enough.
- Use object recognition triggers where a stronger connection between the virtual and physical world are required; however careful choice of subject is necessary.

4.5.13 Summary of design research phases

Conclusions for successfully promoting a flow state have been reached for each phase of the design research investigation. Each phase addressed a variety of different research issues relevant to resolving the ‘wicked design problem’ of designing a PBMG that would engage players in the surrounding environment. In Chapter 5, the results are compiled, and an analysis of the findings is presented, with conclusions for a flow model for PBMGs.
5.1. Introduction

This chapter provides a summary and analysis of the findings across all of the design phases during this project, in answer to the primary research questions. A final set of design guidelines are proposed, combined and iterated from each phase. Taken collectively, the guidelines show how the ‘wicked design problem’ was resolved. They represent a contribution to what Mor (Mor, 2010) refers to as “design knowledge”. The results are also put into context with the work of previous researchers as discussed in the literature review. These design guidelines represent a detailed and bottom up result of considering data, from which broader theoretical contributions are synthesised. In particular, a new model of flow is proposed for PBMGs that can help to provide an optimal experience during play. An evaluation of aspects of the methodology and particular methods developed is also included, as some of them also qualify as research outcomes.

The primary aim of the research was:

- To understand how the properties of PBMGs contribute towards promoting an optimal experience, where a connection with the landscape is significant.

The primary research question was:

- What are the prerequisites for optimising the experience of playing a PBMG?

Interpreted for this particular case:

- What are the prerequisites for optimising the experience when older children play a PBMG in a natural environment?

The aims and questions became more detailed and focused as the investigation proceeded, illustrated by the splitting of the initial question into three further questions, following the literature review.

Question 1: How can the game be designed to offer appropriate levels of challenge, matching the ability of the audience and minimising superfluous effort?

Question 2: What are the attributes of the game that can increase volition to overcome challenges, by targeting and addressing the emotional needs of the player?
Chapter 5: Analysis of Results

Question 3: What are the attributes of PBMG that can help to connect people with place, in this case the natural environment?

The results and their analysis during this chapter will support the answers to these questions.

5.2. Reflections on the methodology

The concept driven design research methodology was successfully used to identify new design guidelines, create artefacts in the form of concept games and generate broader theoretical outcomes, through the analysis in this chapter. It was therefore an appropriate choice, when combined with tools to ensure valid and rich data. However, there were some limitations to the study, due to the nature of doctoral research and the need to maintain the priorities of the project, which will be discussed below.

5.2.1. Methods for cross-checking data

5.2.1.1. Iteration

An iterative approach allowed findings from any given phase to be validated or expanded upon in a subsequent phase. In phase 2, for example, it was observed that setting an approximate distance of 30m between locations appeared to match the physical and cognitive ability of the children for a PBMG in this environment; this assumption was evaluated through a different group of children in phase 3 and found to be appropriate.

It could be viewed that, for some game properties, further iteration could have taken place to find more specific design guidelines or a preferred solution. Taking the use of media types for communicating game goals as an example, there were a considerable number of different variations of images, text or video that could have been evaluated for giving instructions within the game and there will always be new possibilities for using media as technology advances. Although this could be seen as a limit to the study, the solutions that were taken forward, through game prototypes, allowed sufficient playability to offer an ‘appropriate level of challenge’, a key pre-requisite for a flow state. In other words, the solutions chosen were not inhibiting flow. Establishing or ‘tying down’ pragmatic attributes
Chapter 5: Analysis of Results

in this way allowed further focus on critical issues, such as how emotional needs influence the experience of playing a PBMG or the balance of attention between virtual and physical worlds. The issues to be investigated were also iterated and refined during this process, they were also prompted by the experience map, developed during this research.

5.2.1.2. Experience map

Since this project represents an attempt to resolve a wicked design problem, it involves a wide range of different considerations, particularly at the start of the investigation. The use of the experience map helped to classify relevant issues and provided a useful way of prompting the research, ensuring coverage of the dimensions of the game context, alongside the different type of possible response from the player. It was originally my intent to match the areas that were considered with the guidelines that emerged; however, in practice this became unnecessary and impracticable. Sometimes an identified design guideline would belong to several different areas on the experience map. As noted in the previous section, the issues for investigation also changed with iteration over time, along with the design outcomes.

This study did not attempt to evaluate social relationships, through cooperative or competitive play, with other children. Some may consider this to be an omission, for other PBMG’s, however there are some conflicts with including this when considering ‘flow’. For the aims of this project, the child’s connection with the natural environment, through the game was the most significant aspect, rather than other children, even if playing together. However, this aspect could be evaluated through further research.

5.2.1.3. Say, Do, Make (Think)

Using the Sanders et al. (1992) framework for convergent perspectives, to choose methods, helped to enrich the data and cross check results. To illustrate how this was influential, it helps to focus on data that emerged. The online survey 1i) was a ‘Say’ method. In it, a self-reported reason for children not enjoying nature was the presence of insects. However, when observed, via a ‘Do’ research method
1(iii), children appeared to be engaged by insects they found during activities, and later photographed repeatedly, in method 2(ii), often while daring each other to touch them. Fascination with insects was further confirmed during CAS activities for ‘Make/ Think’ methods during phases 2 and 3, when children chose them repeatedly as characters. If the survey had been considered in isolation, insects might not have been included in games. Confronting fears was identified as a means for the child to attempt to address a key emotional need for ‘mastery’ from later investigations and supported by literature through the work of Del Vechio (1997). This example demonstrates the power of the framework to discover latent needs and to point out areas that warrant more investigation.

5.2.1.4. Triangulation and methods

The interviews with nature experts, the online survey with children and later AB testing methods, were helpful in evaluating the pragmatic properties of the games, described by Sanders (2002) as ‘explicit’ needs. Small-scale field studies, observing children and their behaviours at close proximity, in natural environments, for holiday clubs and photography sessions, helped to highlight ‘emergent’ behaviours, as described by Reid et al. (2011) and generally correlate to ‘tacit’ needs in the Sander’s classification. These activities sometimes revealed important information that had not always figured in the research questioning. For example, I became aware of the lack of animal sightings when conducting the holiday club observations, even though the investigation was directed at understanding the activities presented by the experts to children.

The CAS method, however, helped to reveal more of the children’s ‘latent’ or unspoken needs, such as fears about the environment or factors that might improve their sense of purpose or volition during the game. This proved to be an effective way to communicate with children, besides providing ideas for game content that could appeal to subjects of similar age. The emotional needs revealed could be related to the PENS model (Rigby & Ryan, 2011) the findings of which were echoed in the work of other games researchers (Freeman, 2003, Bateman, 2008, McGonigal, 2011).
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The co-design methods involving MORFO and ARIS had mixed success as a way of investigating but were necessary to produce a tangible game for the children. MORFO proved to be so much fun that the children became distracted at times from the main task whereas, conversely, ARIS provided to be more difficult to use and took longer to learn. More time or a different game engine might have produced more finished games for the children. However, this would have been unlikely to reveal any more useful data for research purposes.

5.3. Game design and structure

In this section, information from different phases of investigation will be compared, alongside references from literature and interpreted to summarise the results for the game’s features.

5.3.1. Game type

Through the literature review, it was established that a situated, absolutely positioned LBMG would be the preferred option for connecting people with places, re-defined as a PBMG. The ideal game pattern was also established as being a ‘search and find’ mode (Lehman, 2012), allowing either a ‘treasure hunt’ style game or a ‘story-led adventure style game’ to be included. In the observations of holiday clubs, phase 1 ii), several non-digital games were based on a ‘search and find’ game pattern through ‘treasure hunts’. A similar ‘search and find’ style model, with several points of interest, at different GPS locations, was found to transfer ideally to a PBMG, during the testing of phases 2 and 3. This game pattern could lead players to several areas of natural terrain and allowed a variety of activities to be included, covering a range of the play types discussed by Hughes and Frost (Frost, 1992; Hughes, 2002). Tales that included exploration were also expressed through several of the children’s stories during the CAS activities. A ‘search and find’ model can also encourage exploration when the player arrives at a destination. However, it can also constrain the child’s wandering to within a relatively a safe proximity, somewhat mitigating concerns about stranger danger or other perceived hazards for children playing alone, identified through literature as a key problem when encouraging outdoor play (Barton, 2005; Childwise, 2017). The need for exploration and how it contributes to experiential learning.
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was discussed by various researchers (Randall, 2004; Hsiao, 2010; Rogers, 2010). This type of activity can also appeal to the emotional need for autonomy, according to the PENS group (Rigby & Ryan, 2011) which will also be discussed in relation to the narratives that children produced.

5.3.2. Game sequencing

A linear sequence of GPS points was more enjoyable and easier to follow in this environment than a player-selected sequence, investigated during AB testing during phases 2 and 3. This was surprising, in view of the evidence in the literature that children, of this age particularly, like to make their own choices and wish to have more autonomy over their actions (Del Vechio, 1997; Barroody, 2003; Hyson, 2003; Chalufour, 2004; Hourcade, 2007; Calfee, 2012; Costantino, 2015; Graham, 2015). However, the results may different when playing in groups, as during observations, there were some heated discussions about who would decide the next destinations and a linear sequence avoided this problem. There are, however, several other possible explanations as to why the linear sequence may be preferable: a narrative that unfolds over time may be more familiar to children of this age, so the pattern may be more in keeping with their conceptual model of what to expect. It may reduce cognitive effort by removing decisions about the destination or a feeling of progress and achievement may be more evident with this arrangement. The children were not keen to double back on any of the terrain they had already covered, suggesting a sense of progress was involved, meeting competence needs (Rigby & Ryan, 2011).

However, it is suggested that if the cognitive load associated with wayfinding could be further reduced, or one child was playing, the player-selected sequence might be equally appropriate. This issue could be the subject of further research. However, for this project, the aim is to establish pragmatic guidelines that do not inhibit flow and thus the linear sequence was adopted for further prototyping.

5.3.3. Game genre and narrative

According to the literature, a narrative can help to connect disparate game elements in the mind of the player, creating an effective conceptual model to guide
play (Ardito, 2010). It can therefore provide a means to relate intermediate game goals to an overall game goal. It has also been considered important for immersion (Ritchie, 2014). A narrative can have different relationships with the game play; through direct interaction with a story, typified by the adventure game genre or a more ludic relationship, where a backstory provides a basic premise for the game (Avouris, 2012). Characters (animals in particular) proved popular during the survey and observations in phase 1. This was also confirmed in phase 2, which led to the conclusion that a narrative including animals would be pleasing to the children and more immersive in the natural world, but how it related to the game play and learning about them required investigation.

In AB testing, during phase 3, both game genres were compared through prototype games. An even split of preference was indicated by the children. A larger study, with more participants would be necessary to obtain reliable statistical data. However, for this investigation it was considered unnecessary as both genres were appreciated and unlikely to inhibit flow, and each genre is likely to appeal to the emotional needs of the player in different ways. For example, the story version can create a greater sense of impact and volition through the narrative, when ‘saving the day’ or overcoming villains, in line with techniques discussed by Freeman (Freeman, 2003). The ludic version relates more directly to competence needs, where the player is demonstrating skill through the core mechanics (Areliusarson, 2013).

Although the ludic version was comparably successful with children, a story-based game can also provide a good vehicle for learning and stimulate the player’s imagination about a subject (Ardito, 2010; Avouris, 2012). The narrative in this case could add a structure that would motivate learning about the environment, through the intermediate goal activities. For example, ‘saving the day’ (Freeman, 2003) can become ‘saving the forest’ (possibly by helping creatures along the way), examples of intermediate game goals along the way, might be making an insect hotel or learning about the food that certain animals eat and why this relates to preserving a habitat. ‘Overcoming villains’ can become ‘overcoming threats’ such as invasive species, woven into the story and so on. Symbolic play can be based on a character or story and is used by nature experts,
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based on observations with SWT or the Circle of Life in phase 1. Literature relating to play types (Hughes, 2002, Trust, 2012) also indicates the significance of stories for engagement and remembering experiences.

Thus, it was concluded that there are benefits for the aims of this project to including a story and therefore an adventure game style of game was implemented in later prototypes.

In both cases, the use of a narrative proved to be influential in maintaining engagement with the game. Where children had become distracted by playing in the environment, during observations in phases 2 and 3 of the investigation, continuing with the game goals in order to complete their ‘mission’ was significant in returning their attention to the screen based instructions. However, the game, through the immersive, hands on activities with the physical world, ensured appropriate attention was paid to the environment, when required. Thus the narrative helped to connect these disparate elements (Ardito, 2010, also ensuring a sense of immersion, in the holistic sense of engagement across physical and virtual worlds as Ritchie (2014) had suggested it might.

5.3.4. Design guidelines: basic game parameters

Table 5-1 provides the design guidelines that were established for the basic game attributes, alongside how they were evidenced across phases and through the Say, Do, Make (Think) framework. Some guidelines are specific to the natural environment, and are highlighted in green, while others would apply to PBMGs more widely for any context of play.

Table 5-1 Design Guidelines: basic game attributes for a PBMG.

<table>
<thead>
<tr>
<th>Design Guideline (DG)</th>
<th>Description</th>
<th>Say</th>
<th>Do</th>
<th>Make</th>
</tr>
</thead>
<tbody>
<tr>
<td>DG1</td>
<td>To direct players to specific features in a landscape, the game needs to be <strong>absolutely positioned</strong> to particular GPS points.</td>
<td>Game definitions, chapter 2.2</td>
<td>Literature</td>
<td></td>
</tr>
<tr>
<td>DG2</td>
<td>To direct players to learn about particular locations in the real world, the game should be <strong>site specific</strong>.</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>
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DG3. A ‘search and find’ pattern, with a series of activities at various GPS locations, can provide experience of different terrain and promote exploration.

DG4. A ‘search and find’ pattern can be applied through a ‘treasure hunt’ game (ludic approach) or an adventure game (narrative through story approach): each will appeal to different emotional needs.

<table>
<thead>
<tr>
<th>Notes</th>
<th>Say</th>
<th>Do</th>
<th>Make</th>
</tr>
</thead>
<tbody>
<tr>
<td>Literature Expert Views:</td>
<td>Observations of holiday club</td>
<td>Observations of holiday club phase 1. AB testing phases 2 &amp; 3.</td>
<td></td>
</tr>
<tr>
<td>phase 1</td>
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</table>

DG5. A story-based game can help with learning and stimulate imagination around a subject, also allowing the addition of characters and themes that are appealing to the child.

<table>
<thead>
<tr>
<th>Notes</th>
<th>Say</th>
<th>Do</th>
<th>Make</th>
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<tbody>
<tr>
<td>Literature Expert Views:</td>
<td>Observations of holiday club</td>
<td>Observations of holiday club phase 1. AB testing phases 2 &amp; 3.</td>
<td></td>
</tr>
<tr>
<td>phase 1</td>
<td></td>
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</tbody>
</table>

5.3.4.1. Access and safety

General guidelines about access to the countryside, safety, and responsibility to the natural environment were also discovered, shown in Table 5-2

Table 5-2 Design Guidelines: Ethics & Safety for a PBMG

DG6. General precautions for play (within the natural environment) should be introduced at the beginning of the game to keep the player safe.

DG7. Hazards specific to a particular area, or objects located within it, should be introduced in situ.

<table>
<thead>
<tr>
<th>Notes</th>
<th>Say</th>
<th>Do</th>
<th>Make</th>
</tr>
</thead>
<tbody>
<tr>
<td>Literature Chapter 2.2. Experts view: phase 1.</td>
<td>Observations of holiday club phase 1. AB testing phases 2 &amp; 3.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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The following guidelines, in green, are specific to the case of natural environments:

<table>
<thead>
<tr>
<th>DGC1. Protocols for behavior in the countryside should be included to protect the natural environment.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Notes</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DGC2. Follow NICE guidelines to ascertain suitability of a site for a PBMG based in a natural environment.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Notes</td>
</tr>
<tr>
<td>Specifically, the location should:</td>
</tr>
<tr>
<td>• Be accessible on foot, via cycling or public transport.</td>
</tr>
<tr>
<td>• Not be overtly dangerous to players.</td>
</tr>
<tr>
<td>• Contain indigenous species.</td>
</tr>
</tbody>
</table>

5.3.5. Preferred game content

The results of investigations that reveal children’s preference for the game content will be discussed. However, the guidelines that emerge will be classified later, where consequences for the flow state will be indicated.

5.3.5.1. Preferred activities in the natural world.

Activities offered by wildlife experts (Danks, 2005, Danks, 2009, Danks, 2010; N.T., 2012; Robbs et al., 2015; W.T., 2014) are intended to encourage interaction with the natural landscape to promote experiential learning and therefore have potential as intermediate game goals for a PBMG. The children’s preferences for outdoor activities varied quite widely, according to the survey in phase 1. It was therefore concluded that including a diverse range of activities allowed the game to meet different player abilities, preferences and play types, all of which all have particular benefits for children and their emotional needs, compiled in a list below (Frost, 1992; Hughes, 2002). Psychologists have shown that at this age, children
are keen to show off their expertise in certain areas and therefore including a range of activities can also allow them to show their competence (Del Vechio, 1997; Barroody, 2003; Hyson, 2003; Chalufour, 2004; Hourcade, 2007; Calfee, 2012; Costantino, 2015; Graham, 2015).

**Showing competence:**

**Creative/constructive play:** allowing the child to demonstrate abilities, including art with natural objects or building dens.

**Physical play challenges, including locomotor activities:** these are typified by the adventurer role in the National Trust campaign, for example: rolling down a hill, climbing a tree.

**Collecting natural objects/gamified versions:** typical activities are treasure or scavenger hunts with an overall goal or a competition involved, such as ‘who can spot’ something first.

**Increased autonomy:**

**Mastery play:** these involve control over nature: dam a stream activity.

**Explorative play:** certain activities within the explorer and discoverer role for the National Trust appeal to the emotional needs of free exploration and autonomy over actions. Scavenger hunts and treasure hunts also require the child to investigate and find natural things.

**Deep play- ‘survival’ themes:** these allow children to appear grown up (in this case, self-sufficient) and in control.

**Fantasy and role play:** themes emerge, which may relate to having more importance or control over the fantasy environment, demonstrated by the National Trust, with the adventurer role, and also illustrated by the Woodland Trust, with the nature detective role. Such techniques can be utilised to increase a sense of volition for activity, and a narrative can connect disparate game activities with an overall theme.

**Relatedness:**

**Symbolic play:** some activities display a technique to add characters with human qualities, either by finding or adding them to the scene.

**Nurturing play:** this suggests a relationship to the natural environment, such as making a home for a wild animal.
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Some activities are less suited to a PBMG and had to be excluded, leading to a series of criteria for selection being identified, which included: safety considerations, being understandable without a guide, type of play required and whether they were appropriate for the developmental age. These were shown in Table 4.3 in the results of Phase 1. For example, lighting fires in the absence of an expert guide would potentially be unsafe. Games that included role play might embarrass children of this age and are excluded. During the CAS method, for both phase 2 and 3, creative play activities were not chosen, where an artistic activity served no purpose other to create an aesthetically interesting piece, this contradicted the survey in phase 1. A possible explanation was that the other options offered a stronger sense of volition, especially when connected to the game goals. See CAS, phase 3 for more details. Design Guidelines that refer to the practical choice of activities for a PBMG are provided in Table 5-3.

<table>
<thead>
<tr>
<th>Table 5-3 Design guidelines: pragmatic game properties</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DG 8.</strong> Traditional play activities, adapted for a PBMG, should be safe and understandable without adult supervision.</td>
</tr>
<tr>
<td><strong>DG 9.</strong> Activities should be age appropriate and not embarrassing to the child, e.g. avoid role play activities in public places.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Say</th>
<th>Do</th>
<th>Make</th>
</tr>
</thead>
<tbody>
<tr>
<td>A list of acceptable activities is provided in the Appendix</td>
<td>Survey: phase 1 Experts view: phase 1.</td>
<td>Observations of Holiday Club: phase 1. AB testing: phases 2 &amp; 3.</td>
</tr>
</tbody>
</table>

5.3.5.2. Preferred subjects and game characters

The CAS method and co-designing of games activity during phases 2 and 3 suggested their preferred natural subjects for game characters and also helped to judge their level of knowledge about flora and fauna. The results supported decisions about game content and also revealed the latent needs of the child during the process. A detailed breakdown of characters chosen and their subjects is given in the Appendix, item 8.5.6.
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Characters in the natural context of play
Children showed a fondness for animals in the results of the survey 1 ii); the holiday club observations 2iiii); and co-design activities during phases 2 and 3. Often, they were aware of the more obvious British mammals or creatures, such as foxes, snakes, snails etc. However, as previously mentioned, an observation during the holiday clubs was that sighting animals in the real world is rare.

Previously experts on LBGS noted their potential to show events or content from different timelines through the virtual world, (Walz, 2007; Cook, 2010; Oppegaard, 2014). This led us to the conclusion that virtual animals in the game could mitigate the lack of real specimens, for example showing a badger animation or video during the daytime.

In AB testing and in the development of the children’s games in phase 2, animal characters had been well received, even though they were often based on the children’s own drawings. However, feedback from the children at the end of phase 2 was that they didn’t seem ‘finished’ and that they would have preferred more polished graphics. This led to the inclusion of an investigation where children chose between graphical themes. Both realistic looking and cartoon-like animals were appealing to the child, but because a key aim of this project is to improve recognition and connection with the natural world, the realistic representation was concluded to be the best option.

The children recognised a variety of creatures, but they were referred to in general terms, for example, ‘bird’ rather than the specific species, such as ‘blackbird’. The SWT and other nature experts in Phase 1 i) had indicated the importance of including information about biodiversity. Naming specific species through game characters would therefore be a useful addition to game content.

Characters for any context
The importance of feeling connected with friends was demonstrated through the children’s character drawings in phases 2 and 3, with friendly characters added, (represented as squirrels, rabbits and others, see Appendix item 8.5.6, for
character list). This reflects the ‘relatedness’ emotional need proposed by the PENS (Rigby & Ryan, 2011) and also the work of psychologists who stress the importance of social development through play (Chalufour, 2004). Cooperative play with new people through the game had to be ruled out: the danger associated with locational information about strangers was discussed in the literature, for Pokemon Go! and Foursquare (Hickman, 2010). For this research, the children played in a group and this probably helped with feelings of relatedness, but a child may play alone in future developments. Existing friends could also interact through networked devices in future; however, this approach is beyond the scope of this research. A suggestion from this research was therefore that supportive characters, as friends or allies, should be included in the game to support ‘relatedness’.

The children also frequently chose creatures that could be considered more frightening or unpleasant, such as snakes, spiders, insects or bats, either as ‘heroes’ in the tale, or ‘baddies’ A theory introduced by Del Vechio was that children enjoy engaging with ‘scary’ concepts as it helps them to overcome their fears (Del Vechio, 1997); this could be applied by introducing such creatures as both supportive or antagonistic characters in the game.

5.3.6. Preferred narrative

Children were asked to create a narrative during phases 2 and 3, through a series of CAS exercises. In general, being immersed in a fantasy world can represent a need to escape into an alternative reality, when children don’t feel in ‘control’ in the real world (Del Vechio, 1997). A narrative can also have immersive properties, making the player feel as if they are a part of a different, imaginary world, typified by Pokemon Go! for LBMGs (Das Gupta, 2016).

Rigby and Ryan (2012) refer to the importance of creating a strong sense of volition through a narrative. Children’s stories where the player was ‘saving an animal’ or a mission to ‘save the forest’ provided examples. These themes are suggested to relate to the emotional need for autonomy, referred to by Rigby and Ryan, which they relate the player feeling in control of their actions. Autonomy
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needs can also be met through themes of adventure or the discovery of new places, which were also present in the stories.

Constructive activities were also liked by children, as a narrative, when there was a strong sense of volition or purpose to the activity, such as building shelter for an animal. For non-digital play, these activities are sometimes used by nature experts to teach children about the habitat of creatures; this can lead to feelings of success and being knowledgeable, both of which lead to feeling ‘competent’. Such activities can also be applied as intermediate game goals and, in the concept games created for testing with pupils, were a better fit than when applied as an overall game goal.

For the CAS activities, during phase 2 and 3, the most common storyline involved defeating a foe, which Rigby and Ryan (2011) consider would create feelings of power in a player. Other examples where power struggles manifested included: a character gaining status or being able to do magic to regain control. McGonigal suggests that most players who are addicted to games feel like they are more powerful when in the game world and this is strong a motivation for play. Having power or mastery over a situation is also related to the emotional need for competence by the PENS group (Rigby & Ryan, 2011).

Generally, through both phases 2 and 3, children chose the storylines with elements that could be used to support the player, providing increased power, protection or healing properties, through objects (weapons, magic potions, powerups etc.) or characters. In some cases, the natural environment provided the means for this empowerment, through magical objects weapons, or aptly named ‘power-ups’. A suggestion, therefore, from this research, is that such natural objects (real or virtual) could be used as a possible means to increase a connection with the landscape by representing empowering properties within the game. Theoretically, the fact that nature is making the player feel more powerful in their mission could also help create greater feelings of immersion within the natural environment. This would need further proof but learning about the natural object is a more practical reason to include them in any case.
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Having feelings of competence, through success, power, or mastery and a sense of autonomy, both therefore seem to relate to feelings of control and ‘control’ is an important condition for flow.

Homes and protection and support from family or friends, were also frequently mentioned in the CAS activity. Other stories involved nurturing characters, creating feelings of ‘naches’, according to Bateman (2008) and Lazarro (2004). These themes indicate the emotional need for relatedness (Rigby & Ryan, 2011).

Again, there were a lot of story combinations that could have been tested and how these could be influenced by preference for characters, objects and environments. However, acceptable storylines were identified and the process of creating them revealed latent emotional needs. Table 5-4 details the children’s stories against identified emotional needs.

<table>
<thead>
<tr>
<th>Emotional need (Ryan and Rigby)</th>
<th>Plotlines as a result of CAS</th>
</tr>
</thead>
</table>
| Competence: overcoming fears, leading to a sense of mastery. | • Potentially frightening creatures such as snakes or foxes were included as the hero, a friend, or if as an adversary, were overcome during the narrative.  
• Insects were included as characters in the game (despite an aversion flagged in the survey, phase 1).  
• A deer character overcoming an evil elf, who represents ‘bad things’ in the natural environment in abstract form.  
• Empathy was created with a bat, (despite his occasionally poor behavior, he is only nasty when unconfident). |
| Competence: Power | • Various examples of characters winning battles.  
• Finding or making weapons from natural materials to help with a battle.  
• Winning possessions, such as gold or a home.  
• Overcoming adversaries through trickery or game play.  
• Gaining ‘super-powers’ through picking up natural collectables.  
• Using magic potions, made from natural things or gaining magical powers. |
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| Competence: Demonstrating skills | • Having increased status, for example through taking over the world or becoming a queen.  
• Saving ‘the day’, the forest or other animals.  
| Competence: Constructing a home using natural things.  
| Autonomy: Exploring to find things  
• Having an adventure  
• Choosing weapons  
• Choosing wild food or friends  
• Choosing objects to get superpowers  
• Having a sense of volition when saving the forest or the world.  
| Relatedness Support in the game mission from friends and family.  
• Making new friends.  
• Saving other creatures or being saved by others from a baddie.  
• Nurturing a sick animal or creature.  

5.3.7. Key findings: characters and narratives for PBMGs

The findings for these aspects of the game content cover a wide variety of issues surrounding prerequisites for flow and therefore design guidelines will be detailed in the relevant category in 5.4. However, the following summarises the conclusions reached across phases:

General points:

• It is possible to include informal experiential learning about different species as part of the game narrative through its characters and objects to be collected.

• PBMG’s have the potential to present events, objects and characters when they are not currently available. To address children’s affection for animals and the potential lack of sightings in the real world, virtual animals could be included in the game.

• Competence needs

• Natural creatures that are potentially frightening to children can be dealt with by introducing them through characters in the game. This could allay some fears about being present in a natural environment.
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- Stories created by children frequently had themes of winning battles and overcoming bad guys. Mechanisms that gave increased power were often introduced, such as the use of magic spells, or ‘power-ups’. Having more ‘power’ is a way to feel more in control of a situation.
- ‘Collectables’, or objects that can be obtained to support a game mission and protect or empower the player can be based on natural subjects. This can afford learning opportunities about their properties and may increase a connection with nature.
- Some stories were based on practical construction projects, e.g. animal homes. This kind of project can lead to feelings of mastery but can also help to deliver information about nature and biodiversity, potentially also engaging the child in the natural processes. Activities typical of this type were best presented as intermediate game goals, rather than an overall game goal.

Autonomy needs
- Creative play activities are not preferred when there is no perceived purpose and sense of volition towards a mission.
- Children enjoyed freely exploring and operating independently during field observations and testing. This is considered a facet of the need for autonomy by Rigby and Ryan (2011) and is also helpful for experiential learning.

Relatedness
- Friends, family and cooperative play featured strongly throughout the research to provide protection and support when carrying out a mission or surviving in the natural environment.
- The need to address the emotional need of ‘relatedness’ during play is important for children to feel supported in this environment, this could be also addressed through virtual characters in the game.
- The concept of ‘naches’ where the child could help other characters were significant, suggesting impact in the game and power.
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5.3.8. Natural features and game play.

During the photography sessions, in phases 2 and 3, a series of common characteristics were noticed when the children chose areas and features of interest in the countryside. A table showing their full choices for each phase is given in the Appendix, items 8.5.10 and 8.6.7 respectively. Some choices afforded a certain type of play, for example trees affording climbing, in accordance with Norman’s (2005) and Fjortoft’s (2004) work. A list of typical affordances was given in section 2.3.5. Others contained index signs, for example, indicating signs of growth, animal or insect activity. Iconic signs, such as metaphorical associations with human characteristics, were also noticed and other features had symbolic associations, such as reflections on previous experience or stories from their past. There were also photographs of areas of visual contrast in the landscape that stood out from the rest of the environment. These signifiers were seen to draw the child’s attention in an otherwise complex landscape. These activities, along with observations of how children engaged during the holiday club workshops in Phase 1, pointed to the importance of ‘feedforward’ in their engagement with the landscape.

When testing concept prototypes during phases 2 and 3 and observing the children making their own games, the feedforward in the environment was noted to play a further, related role in forming meaningful and visually distinctive destinations which could help the children to navigate the space and play a part in wayfinding around a difficult terrain.

Though children knew common plant types by name, such as: nettles, daisies or dandelions, few knew what an elderflower was. After game testing, where elderflowers were included, two groups added it to their own production, during the later co-design activity. This suggests the games have the potential to expand their knowledge.

Several researchers in the area of mobile learning have experimented with learning and species recognition, with examples from botany, birds, butterflies etc. (Rieger, 1997; Chen, 2004; Huang, 2010), however the activities were related to a school curriculum and did not represent an experience of play that would
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necessarily be engaged with voluntarily. There is evidence that many such educational games do not always meet the emotional needs of players (Car-Chellman, 2010). It seems there is a balance required between the volume of educational content and maintaining game enjoyment. However, the primary aim of this game is to encourage young people to play outdoors, hence the attempt to provide as an ideal experience as possible (maintaining flow), hence learning about a few new species each time, through the game characters seems acceptable.

There are also new developments for Apps that allow children to recognise simple repeatable shapes in nature. LeafSnap, for example, can identify a tree type from its leaf (Jacobs, 2016). At the time of writing, this technology is in its infancy and cannot recognise sufficient variety of natural subjects accessibly enough to be included in this type of game. However, it may be a possible addition to future games if the technology advances.

5.3.9. Wayfinding and media

A significant issue identified through the literature (Cole et al., 2003; Stanton Fraser et al., 2005; Frohberg, 2009; Eliasson, 2011) and observations during phase 2, was too much focus on the screen, especially during wayfinding. This reduces focus on the environment, an aim of the project. The practical usability (defined by Preece et al. 2012) associated with wayfinding should therefore be optimised as far as possible.

The choice of media can influence usability. It was noted that there are three different use ways to use media representations to direct the player:

1. Icons to show a location on the map (limited to a word and/or image in most LBMGs)
2. Media to direct the player to the next point after they have carried out an activity (a written description, an image or video in current LBMGs)
3. Visual feedback about arriving at desired location (ARIS deals with this automatically as the point becomes accessible and notifies the player through the interface and sound).
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The solution that emerged as most successful for a map icon in AB testing during phase 2 and 3 was an image of a destination with a brief title; this also effectively provided information and hence ‘feedforward’ about what the player is looking for.

However, from observations during AB testing of phases 2 and 3, the most critical of these stages was when setting off to find the next destination after an activity, due to issues with map reading and a slow GPS response. Using a character to describe the directions, investigated in phase 3, was partially successful, but still required head down interaction. The use of pre-recorded video to demonstrate walking through the landscape was successful in orienting the player and helped to remove attention from the screen towards the landscape, investigated in phase 4. This again, could be considered as feedforward for the player.

Upon arrival at a destination, feedback is provided through the game engine as an object or marker appears on the map for the player to select. The sensitivity of this proximity can be set by the game maker but was found to be preferred at around 5 to 10 m to make this stage easier.

These findings point to the key role that both feedforward and feedback play in the interactions of the player with the game and the landscape during wayfinding.

5.4. Findings and prerequisites for flow

5.4.1. Appropriate level of challenge

Having a challenge that is attainable and perceived to be attainable is key to achieving a flow state. This pre-requisite for flow focusses on the first research question being investigated:

*Research Question 1: How can the game be designed to offer appropriate levels of challenge, matching the ability of the audience and minimising superfluous effort?*

It is important to reiterate that the design research conducted to consider appropriate levels of challenge was based on establishing a threshold of ability typical of this age group, avoiding activities or content that will be too difficult to perform or understand, so that other factors relating to flow can be examined. The
inclusion of a range of play types and activities, as intermediate game goals, is also intended to address differences in both skills and preferences.

The level to which that children succeeded in performing the activities varied, though this is mostly subjective for the kind of activities included. Often, they were able to judge their own success. For example: an intermediate game goal to make a den and photographing it, can be done within the limits of most children’s ability, but some would spend longer and possibly create a better example.

Essentially, it is never possible to design the ideal game for all, but working closely with children, alongside learning from previous research, has helped to generate a set of design guidelines that would create the best fit for a majority. Where terrain is undulating, for example, as many natural environments can be, it is difficult to include all ranges of physical ability.

<table>
<thead>
<tr>
<th>Table 5-5 Design Guidelines for level of challenge</th>
</tr>
</thead>
<tbody>
<tr>
<td>DG10. Activities should be safe and at an appropriate level of challenge for the developmental age of the player.</td>
</tr>
<tr>
<td>Say</td>
</tr>
<tr>
<td>Suitable activities for this environment were identified in Table 4.2.</td>
</tr>
</tbody>
</table>

DG11. The total duration should be less than 90 minutes for older children.

DG12. Intermediate activities should be between 15 and 30 minutes.

DG13. The number of locations should be calculated using the approximate time to carry them out, but overall should not exceed the recommended duration of total play.

DG14. Locations should not be more than 30m apart to avoid losing focus.

DG15. GPS sensitivity should be set to 5m or more.

DG16. Opportunities for rest should be factored into the game.

DG17. A ‘race against time’ game pattern is not suitable to promote a connection with an environment.
Chapter 5: Analysis of Results

Design Guidelines related to physical challenge are provided in Table 5-6.

Table 5-6 Design Guidelines for level of physical challenge

| DG18. Include activities that are at an appropriate level of physical challenge, by considering: physical size, movement capability and strength. |
| Notes | Say | Do | Make |

Design Guidelines related to cognitive challenge are provided in Table 5-7

Table 5-7 Design Guidelines for level of cognitive challenge

| DG19. Include activities that are at the appropriate level of cognitive challenge for the developmental age of the player. |
| DG20. Minimise the need to read on screen and use language of an appropriate level. |
| DGC3. Choose activities recommended by nature experts that are at an appropriate level of challenge for children of this age to learn about nature. |
| Notes | Say | Do | Make |
| Suitable activities for this environment were identified in Table 4.2. | Literature | AB testing: phase 2 & 3. | Co-designing with ARIS: phase 2 & 3. |

5.4.2. Clear Overall and Intermediate Goals

A flow state prerequisite is that the player must understand what is expected of them in terms of the overall game goal and the intermediate activities that contribute towards it.
## Chapter 5: Analysis of Results

### Table 5-8 Design Guidelines for Clear Goals

#### DG21. Overall goals should be clear and presented early.

<table>
<thead>
<tr>
<th>Notes</th>
<th>Say</th>
<th>Do</th>
<th>Make</th>
</tr>
</thead>
<tbody>
<tr>
<td>Literature</td>
<td>AB testing:</td>
<td>Co-designing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>phase 2 &amp; 3.</td>
<td>with ARIS: phase 2 &amp; 3.</td>
<td></td>
</tr>
</tbody>
</table>

#### DG22. Intermediate goals should be clear and presented at appropriate times.

<table>
<thead>
<tr>
<th>Say</th>
<th>Do</th>
<th>Make</th>
</tr>
</thead>
<tbody>
<tr>
<td>Literature</td>
<td>Observations:</td>
<td>Co-designing</td>
</tr>
<tr>
<td></td>
<td>phase 1.</td>
<td>with ARIS: phase 2 &amp; 3.</td>
</tr>
<tr>
<td></td>
<td>AB testing:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>phase 2 &amp; 3.</td>
<td></td>
</tr>
</tbody>
</table>

#### DG23. Consider the ability of the audience to rationalise and understand the intermediate and overall game goals.

#### DG24. Consider the use of audio or video to deliver game goals for all audiences.

<table>
<thead>
<tr>
<th>Say</th>
<th>Do</th>
<th>Make</th>
</tr>
</thead>
<tbody>
<tr>
<td>Literature</td>
<td>AB testing:</td>
<td>Co-designing</td>
</tr>
<tr>
<td></td>
<td>phase 2 &amp; 3.</td>
<td>with ARIS: phase 2 &amp; 3.</td>
</tr>
</tbody>
</table>

#### DG25. A narrative should be included to set the scene for the game goals

#### DGC 4. A narrative based on the natural environment can set the scene for the game goals aiding learning about the landscape and immersion.

<table>
<thead>
<tr>
<th>Say</th>
<th>Do</th>
<th>Make</th>
</tr>
</thead>
<tbody>
<tr>
<td>Literature</td>
<td>AB testing:</td>
<td>CAS: phase 2 &amp; 3.</td>
</tr>
<tr>
<td></td>
<td>phase 2 &amp; 3.</td>
<td>Co-designing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>with ARIS: phase 2 &amp; 3.</td>
</tr>
</tbody>
</table>
Chapter 5: Analysis of Results

5.4.3. Control: overcoming challenge through volition

According to Sweetser and Wyeth, a game should be ‘controllable’ to facilitate a flow state (Sweetser & Wyeth, 2005). The player needs to be able to use the game controls in a practical sense effectively and direct the game actions; this relates to basic usability (playability); and may be what they were referring to in their model. However, Jordan (2002) and Norman (2005) point to the importance of including both pragmatic and emotional concerns when considering an experience holistically and the fact that these concepts are interrelated. Feelings of being ‘in control’ within the game have been discussed in terms of emotion and are regarded as pivotal to game success, due to their role in motivating and engaging the player (Freeman, 2003; Yee, 2007; McGonigal, 2011, Rigby and Ryan, 2011). Feelings of control can be present through both the core mechanics (Yee, 2007) and the narrative (Freeman, 2003).

The research findings in this thesis that relate to matters of control, therefore provide solutions to the second part of the question:

*Research Question 2: What are the attributes of the game that can increase volition and entice the player to overcome challenges, by targeting and addressing the emotional needs of the player?*

Rigby and Ryan (2011) provided three categories of emotional need: ‘competence’, where the player feels a sense of achievement, or more masterful through the game, ‘autonomy’, where players are allowed self-expression through a sense of individual purpose, volition or the freedom to make choices and ‘relatedness’ where the player feels connected with other beings. Considering
detailed design guidelines related to the emotional needs of children, during this research, led to the conclusion that the two categories, competence and autonomy are both facets of feeling in control, represented in the diagram in Figure 5-1.

![Figure 5-1 Emotional needs as facets of 'control', a flow pre-requisite.](image)

Latent emotional needs were expressed by the children during the CAS activities across design research phases 2 and 3. Competence needs were seen to manifest through their drawings, showing for example, a desire to gain power through the game, overcome fears, show off their skills or have increased status. The need for autonomy was demonstrated in their drawings through examples where the character led an important mission, was independent, could explore freely, go on adventures or choose different options. A more detailed list of CAS storylines and their interpretation was given in Table 5-4. Literature findings also supported particular manifestations of children’s need for control, in theory because they have relatively little autonomy or power in their lives compared with adults (Del Vechio, 1997; Barroody, 2003; Hyson, 2003; Chalufour, 2004; Hourcade, 2007; Calfee, 2012; Costantino, 2015; Graham, 2015). Examples included: wishing to be part of a fantasy world, where they feel more in control, situations where they overcome childhood fears and areas where they push boundaries to assert their power. General observations that the children were able to express feelings through the story-based activities also supported the conclusion that a story-based game was most useful to address the needs of children flexibly and encourage an emotional connection with a location.

Design guidelines related to control as a pre-requisite for flow are represented in the guidelines summarised in Table 5-9.
# Chapter 5: Analysis of Results

## Table 5-9 Design Guidelines for Control

<table>
<thead>
<tr>
<th>DG27. Players should feel a sense of control over the game play.</th>
<th>Notes</th>
<th>Say</th>
<th>Do</th>
<th>Make</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Literature, Ch 2.2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DG28. The core game mechanics should consider the emotional response of the player and be appropriate for the intended audience.</th>
<th>Notes</th>
<th>Say</th>
<th>Do</th>
<th>Make</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Literature, Ch 2.2</td>
<td>AB Testing: phases 2 &amp; 3.</td>
<td>CAS, Co-Design; phases 2 &amp; 3.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DG29. A range of play types should be included to address different emotional needs relating to control.</th>
<th>Notes</th>
<th>Say</th>
<th>Do</th>
<th>Make</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Literature, Ch 2.2</td>
<td>AB Testing: phases 2 &amp; 3.</td>
<td>CAS, Co-Design; phases 2 &amp; 3.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DG 30. Allow the player to demonstrate their skills (competence) and creativity (autonomy) in key areas of expertise.</th>
<th>Notes</th>
<th>Say</th>
<th>Do</th>
<th>Make</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Literature, Ch 2.2</td>
<td>AB Testing: phases 2 &amp; 3.</td>
<td>CAS, Co-Design; phases 2 &amp; 3.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DG31. Avoid anxiety about difficult tasks.</th>
<th>Notes</th>
<th>Say</th>
<th>Do</th>
<th>Make</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Literature, Ch 2.2</td>
<td>AB Testing: phases 2 &amp; 3.</td>
<td>CAS, Co-Design; phases 2 &amp; 3.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DG32. Introduce overall goals in terms of key emotional needs:</th>
<th>Notes</th>
<th>Say</th>
<th>Do</th>
<th>Make</th>
</tr>
</thead>
<tbody>
<tr>
<td>E.g., Competence: “save the world”; Autonomy: “explore the world and find…”; Relatedness: “save the people of …”</td>
<td>Literature, Ch 2.2</td>
<td>AB Testing: phases 2 &amp; 3.</td>
<td>CAS, Co-Design; phases 2 &amp; 3.</td>
<td></td>
</tr>
</tbody>
</table>
DG33. Introduce intermediate game goals in terms of key emotional needs:

<table>
<thead>
<tr>
<th>Notes</th>
<th>Say</th>
<th>Do</th>
<th>Make</th>
</tr>
</thead>
<tbody>
<tr>
<td>e.g. Competence: “scale the obstacle”; Autonomy: “choose which character to talk to, the preferred path to take, etc.”; Relatedness: “save your friend, or kill the baddie”.</td>
<td>Literature, Ch 2.2</td>
<td>AB Testing: phases 2 &amp; 3.</td>
<td>CAS, Co-Design; phases 2 &amp; 3.</td>
</tr>
</tbody>
</table>

Notes

Where competence needs are to be emphasised:

**Table 5-10 Design Guidelines relating to competence needs and control**

| DGC 5. Including species identification and recording tasks, alongside gamification of the tasks, can add to feelings of competence. |
| DGC 6. Including constructive play based on natural subjects can be educational and address competence needs. |

<table>
<thead>
<tr>
<th>Notes</th>
<th>Say</th>
<th>Do</th>
<th>Make</th>
</tr>
</thead>
</table>

DG34. Including constructive play can address competence needs.

DG35. Include game narratives that allow the player to feel powerful, such as winning a battle, overcoming an adversary or increasing their status.

DG36. Allow the player to overcome latent fears about the environment, by addressing them through the narrative and characters in the game.

DG37. Include objects and characters that support the empowerment of the player.
Chapter 5: Analysis of Results

Where autonomy needs are to be emphasised:

<table>
<thead>
<tr>
<th>Table 5-11 Design Guidelines relating to autonomy needs and control</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DG37.</strong> Players, once in appropriate GPS locations, should be encouraged to explore the physical world independently, through an intermediate game goal activity.</td>
</tr>
<tr>
<td><strong>DG38.</strong> Allow the discovery of new terrain and characters, independently without a human guide.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Say</th>
<th>Do</th>
<th>Make</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ch 2.2</td>
<td>Literature</td>
<td>AB Testing: phases 2 &amp; 3.</td>
</tr>
</tbody>
</table>

**DG39.** Create a sense of volition in the player through the game narrative.

**DG40.** Players should feel a sense of impact in the game world, like their actions matter.

<table>
<thead>
<tr>
<th>Say</th>
<th>Do</th>
<th>Make</th>
</tr>
</thead>
<tbody>
<tr>
<td>Literature</td>
<td>AB Testing: phases 2 &amp; 3.</td>
<td>CAS, Co-Design; phases 2 &amp; 3.</td>
</tr>
<tr>
<td>Ch 2.2</td>
<td>Literature</td>
<td></td>
</tr>
</tbody>
</table>

**DG41.** Allow children to ‘push the boundaries’ and express their own opinions, where appropriate.

<table>
<thead>
<tr>
<th>Say</th>
<th>Do</th>
<th>Make</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ch 2.2</td>
<td>Literature</td>
<td></td>
</tr>
</tbody>
</table>

**DG42.** Forms of imaginary play should be included, to allow feelings of control in fantasy worlds.

<table>
<thead>
<tr>
<th>Say</th>
<th>Do</th>
<th>Make</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ch 2.2</td>
<td>Literature</td>
<td>AB Testing: phases 2 &amp; 3.</td>
</tr>
</tbody>
</table>
5.4.4. Concentration and Balance of Attention

Being able to pay attention to appropriate stimuli influences concentration on a task is critical to a state of flow. However, the flow state also involves a feeling of timelessness, together with an ‘out of body’ experience. The player is either in a flow state, or they are not, whereas levels of concentration can vary on a spectrum from being wholly focused to totally distracted. In previous models of flow for games, concentration was considered a consequence, rather than a prerequisite for flow, but during this research, a series of guidelines emerged that can support the design of game properties to improve the way players will concentrate on significant stimuli.

An issue emerging from the literature was that concentration is challenged when a player’s attention is divided across real and virtual worlds. Moreover, a common problem reported by previous researchers was that an overly large amount of attention being paid to the screen. Since an important aspect of this research is for the PBMG to enable a connection with place, solutions were needed that would draw attention to the real world at appropriate times. Design guidelines developed by previous researchers had suggested that ‘attention switches’ between the two worlds should be planned into the game design. Findings during the design research phases help to consider how this is made possible through the design of the game. Firstly, outdoor activities such as those referred to in section 5.3.4.2 were included as intermediate game goals, when attention would have to switch to the real world. The activities were developed by consulting relevant literature and observing the work of nature experts, during phase 1. Typical examples were evaluated during phase 2 and 3 to check their transferability to the PBMG and that the criteria used for selection were effective. Subsequently the game narrative and goals would encourage the player to return their attention back to the virtual aspect of the game.

Findings, during the photography exercises also offered ways to draw more attention to the landscape through the meanings, affordances and visual properties of the objects within the natural environment and their situation.
Chapter 5: Analysis of Results

A critical time for concentration is during wayfinding, where the player may follow their GPS location on a map but also need to look where they are going. A technique to help reduce time looking at the screen is to optimize usability when wayfinding. Design guidelines relating to these aspects are given in Table 5-8.

<table>
<thead>
<tr>
<th>Table 5-12 Design Guidelines for Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>DG43. The player’s attention should be balanced appropriately across the virtual and physical aspects of the game world.</td>
</tr>
<tr>
<td>DG44. Consider ability to pay attention to multiple stimuli and where attention should be directed, plan in focus switches to the game.</td>
</tr>
<tr>
<td>DG45. Include activities in the real world as intermediate game goals.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Say</th>
<th>Do</th>
<th>Make</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples of intermediate game goal activities taken from examples by nature experts.</td>
<td>Literature.</td>
<td>Phase 1. Prototype testing: phase 2, 3, 4</td>
</tr>
<tr>
<td>DG46. Do not use animations or moving images, if the application is meant to be in the background.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DG47. Reduce features on the game interface as much as possible.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Say</th>
<th>Do</th>
<th>Make</th>
</tr>
</thead>
<tbody>
<tr>
<td>Literature</td>
<td>Prototype testing: phase 2, 3, 4</td>
<td></td>
</tr>
<tr>
<td>DG48. Use triggers for media via GPS location where easy activation is a priority, in areas with good signal.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DG49. Use object recognition triggers, where a connection between the virtual and physical world is prioritised over easy activation.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Notes</th>
<th>Say</th>
<th>Do</th>
<th>Make</th>
</tr>
</thead>
<tbody>
<tr>
<td>Issue raised during phase 3 of the investigation as relevant to balance of attention.</td>
<td>Prototype testing: phase 4.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Chapter 5: Analysis of Results

DGC7. Use preferred natural subjects, natural affordance, signifiers and areas of contrast to draw attention to points of interest for activities.

<table>
<thead>
<tr>
<th>Notes</th>
<th>Say</th>
<th>Do</th>
<th>Make</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAS helped to identify natural subjects, the photography exercise</td>
<td>Literature</td>
<td>Observations:</td>
<td>CAS and Photography exercises: phase 2 &amp; 3.</td>
</tr>
<tr>
<td>identified meaningful locations, the literature helped to understand why such meanings may exist.</td>
<td>Survey: phase 1.</td>
<td>phase 1.</td>
<td></td>
</tr>
</tbody>
</table>

The following guidelines are relevant to concentration and balance of attention but apply specifically to wayfinding.

**Table 5-13 Design Guidelines for Concentration and Wayfinding**

DG50. Ensure that wayfinding activities do not require excessive attention and attention to the screen, to make them safe.

<table>
<thead>
<tr>
<th>Say</th>
<th>Do</th>
<th>Make</th>
</tr>
</thead>
<tbody>
<tr>
<td>Literature</td>
<td>AB testing: phase 2 &amp; 3.</td>
<td></td>
</tr>
</tbody>
</table>

DG51. The map should show as much detail about landmarks as possible, (for a natural environment, the 'terrain' setting is more informative).

DG52. Map icons should include images of areas or objects to be found, to aid recognition of a location, along with a text description to avoid ambiguity.

<table>
<thead>
<tr>
<th>Say</th>
<th>Do</th>
<th>Make</th>
</tr>
</thead>
<tbody>
<tr>
<td>AB testing: phase 2 &amp; 3.</td>
<td>ARIS game activity and testing: phase 2 &amp; 3.</td>
<td></td>
</tr>
</tbody>
</table>

DG53. Use locations that are visually striking or have meaningful affordances to aid with recognition and wayfinding.

<table>
<thead>
<tr>
<th>Say</th>
<th>Do</th>
<th>Make</th>
</tr>
</thead>
<tbody>
<tr>
<td>Literature</td>
<td>AB testing: phase 2 &amp; 3.</td>
<td></td>
</tr>
</tbody>
</table>
5.4.5. Feedback

Feedback is described as an interaction principle by Norman (2002) and is also considered a pre-requisite for flow (Csikszentmihalyi, 2002). Feedback plays a role in notifying players about what they have achieved, can make them aware of the choices they have made, provide information about progress on their route and indicates their overall progress through the game, besides communicating back to the player many other minor interactions with the game.

During this research it was noted that feedback appears to be associated with the successful fulfillment with all of the other pre-requisites. For example, clear feedback can help to make interactions with the screen easier and reduce levels of challenge. Information about location will contribute towards effective concentration and rewards can increase a sense of achievement and contribute to empowerment and feelings of control. The consequences of this observation will be discussed in section 5.5, where modifications to the flow model are proposed. Feedback was also found to correlate with ‘feedforward, which will also be discussed further in section 5.5.

The following guidelines relate to the prerequisite for feedback:

<table>
<thead>
<tr>
<th>Notes</th>
<th>Say</th>
<th>Do</th>
<th>Make</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ch 2.2 &amp; 2.3.</td>
<td>Literature</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 5-14 Design Guidelines for Feedback
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5.4.6. Flow and Immersion

A flow state has been described as the state of being so immersed in an activity that nothing else seems to matter and time disappears (Czikszentmihalyi, 1990). Jennett et al. (2008) suggest that a related concept of ‘immersion’ provides:

... an appealing distraction from everyday worries and concerns, computer games allow people to “lose” themselves in the world of the game.

Researchers at the Game Experience Research Lab at the Eindhoven University of Technology suggest that there is little distinction between flow and immersion,

| DG58. Inform the player about progress towards overall game goals. |
| DG59. Provide immediate, clear feedback when players have achieved intermediate challenges. |
| DG60. The game should inform players about their location through GPS within timescales acceptable to the audience and their game goals. |
| DG61. The game should respond to arrival at a GPS location within a distance of no less than 5m |

<table>
<thead>
<tr>
<th>Notes</th>
<th>Say</th>
<th>Do</th>
<th>Make</th>
</tr>
</thead>
</table>

| DG62. The game should notify players when they have arrived at a destination. |

<table>
<thead>
<tr>
<th>Notes</th>
<th>Say</th>
<th>Do</th>
<th>Make</th>
</tr>
</thead>
</table>

| DG63. Players should be compensated for achievement, through rewards. |

<table>
<thead>
<tr>
<th>Notes</th>
<th>Say</th>
<th>Do</th>
<th>Make</th>
</tr>
</thead>
</table>

| DG64. Give feedback to make players aware of the choices they have made. |

<table>
<thead>
<tr>
<th>Notes</th>
<th>Say</th>
<th>Do</th>
<th>Make</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAS: Choosing certain natural objects led to particular game advantages, power ups etc.</td>
<td>AB testing: 3.</td>
<td>CAS: phase 2 &amp; 3.</td>
<td></td>
</tr>
</tbody>
</table>
Chapter 5: Analysis of Results

but that the latter term is more descriptive and recognised for games (Ijsselsteijn et al., 2007). These perspectives and investigations during this thesis led to the conclusion that a state of flow and ‘immersion’ can be considered synonymous.

For a PBMG, the concept of immersion should be considered from the perspective of both virtual and physical worlds and creating a more seamless interface between the two. Immersion is therefore promoted by meeting the previously described design guidelines collected through this research, such as appropriate levels of challenge and feelings of control. However, there are also game properties identified that were seemingly independent of previous categories, still likely to influence immersion.

In the literature review, it was noted that the best way to connect children with a natural environment is by encouraging them to play there in the first place. In this case, the natural landscape should specifically enhance the ‘flow’ of information about nature through immersion. Ermi and Mayra (2005) also refer to ‘presence’ as an aspect of flow, meaning feeling that one is situated within an environment. As this applies to the real world, for PBMGs, the concept of immersion, particularly when also considered as ‘presence’, relates to certain aspects of the third main area of questioning:

Research Question 3: What are the attributes of the game that help to connect people with place (in this case the natural environment)?

Traditional play activities, introduced by wildlife experts, are particularly designed to increase interaction and engagement with the landscape. They were observed during phase 1 and successfully implemented into the game during phases 2 and 3. In some cases, a physical interaction was provoked, such as picking up an insect or making a den. In other examples there were ‘sensory’ experiences, such as listening to bird song or smelling flowers. Sensory play was not identified as a play type in the definitions in chapter 2.3 (Frost, 1992, Hughes, 2002); however, it is a common feature of outdoor workshops for young people. An immediate sensory reaction to aspects of the environment appears to correspond to the ‘visceral’ response described by Norman (2005).
A game narrative has been considered to hold together disparate game elements, especially important when played in a physical environment (Ritchie, 2014) promoting immersion through the fantasy world it creates. This is besides supporting emotional needs that encourage engagement with the game (Rigby & Ryan, 2011). In this project, the narrative appeared to encourage the child to resume interest in the game following their engagement with physical activities in the environment. It proved to be conducive to maintaining the flow of the game and, therefore immersion, across both virtual and physical worlds. Where objects and features of the real world were related to the fantasy world, for example as ‘power ups’ in the game, immersion in the natural landscape was also promoted and the two worlds connected. Similarly, where virtual media was superimposed upon the real environment, a more seamless connection between the two worlds and a sense of immersion across both was promoted.

The graphics of a game have been strongly associated with levels of immersion by other researchers, but as immersion in the real environment is also critical, this aspect was less significant for PBMGS. Player’s preferences also influence their emotional response and thus addressing them can avoid psychological barriers to play. Choosing colourful or striking objects in the environment, during the photography, phases 2 and 3, relates to a visceral response, drawing attention to the environment.

Immersion could also be considered from the perspective of feeling engaged in the game during the process of an interaction; this corresponds with the ‘behavioural’ response according to Norman. The activities that promote physical interaction with the landscape to achieve a particular goal, such as building a den relate to this kind of immersion. Preferences for natural content and game features were observed which may also depend on previous experience and memory. This relates to a ‘reflective’ response described by Norman (2005). Children’s existing attitudes and fears towards nature, discussed in the literature of chapter 2.3, and investigated in the survey, during phase 1, will also be intrinsic to their enthusiasm towards outdoor activities. In the CAS activities and the photography of phases 2 and 3, the children chose examples of familiar natural objects and also ones that may have previously been challenging, discussed in
section 5.3.5.2. Some reflective responses relate to negative experiences and overcoming latent fears in the environment through emotional needs corresponds to the concept of control, but other experiences that were discussed by children, especially those that are happier, do not, such as memories of picking and eating blackberries.

In summary, there is evidence to indicate a connection between Norman’s categories of emotional response in the findings and the design guidelines below and factors that lead to immersion. However, these assumptions will be questioned and discussed in light of the work of other researchers into immersion in section 5.5, where modifications to the flow model for PBMGs are described. Design Guidelines relating to general properties of immersion are provided in Table 5-15, those in Table 5-16 are specific to the child’s preferences for this case.

<table>
<thead>
<tr>
<th>Table 5-15 Design Guidelines relating to Immersion</th>
</tr>
</thead>
<tbody>
<tr>
<td>DGC9. Traditional non-digital play activities involving interaction (with the natural world) should be included as intermediate goals to create engagement with the landscape.</td>
</tr>
<tr>
<td>DGC10. Activities recommended by nature experts can encourage children to learn about biodiversity and increase knowledge of their surroundings.</td>
</tr>
<tr>
<td>Say</td>
</tr>
<tr>
<td>Literature</td>
</tr>
<tr>
<td>DG65. Functional Play should be included to stimulate activity with the landscape (and support wellbeing)</td>
</tr>
<tr>
<td>DG66. Physical play types should be included, (where considered safe by experienced nature guides).</td>
</tr>
<tr>
<td>DG67. Sensory Play should be included to heighten awareness.</td>
</tr>
<tr>
<td>DG68. Exploratory Play should be included to promote independent activity with the landscape.</td>
</tr>
<tr>
<td>Say</td>
</tr>
<tr>
<td>Literature</td>
</tr>
<tr>
<td>AB testing</td>
</tr>
<tr>
<td>Say</td>
</tr>
<tr>
<td>Literature</td>
</tr>
</tbody>
</table>
Chapter 5: Analysis of Results

5.4.6.1. Immersion and player preferences

The following guidelines specifically relate to the preferences of older children.

<table>
<thead>
<tr>
<th>DGC 11. Constructive Play can be included to show the utility of nature and to promote learning.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Say</td>
</tr>
<tr>
<td>Activities include making homes for animals or other creatures or using nature for practical purposes that can enable learning</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 5-16 Player preferences and immersion</th>
</tr>
</thead>
<tbody>
<tr>
<td>DGC 12. Include activities with preferred natural species and content in the game.</td>
</tr>
<tr>
<td>Say</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DGC 13. Include preferred animal or mini-beast characters virtually, especially in the absence of specimens in the real world.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Say</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DGC 14. Use locations that are meaningful or striking to the child to support immersion in surroundings.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Say</td>
</tr>
</tbody>
</table>

5.5. Modifications to the Flow Model for PBMGs

In this section, we will describe how the detailed findings suggest a modified model of flow for PMBG's.
5.5.1. Immersion and Player Response

During the investigation, several different ways to promote immersion were noted. Immersion is necessarily considered across both the virtual game and the landscape, with organized attention switches between the two. Guidelines emerged relating to both the properties of the virtual game and the real environment that could influence overall engagement. Rigby and Ryan (2011) suggest that immersion relates to aspects of physical, emotional and narrative ‘presence’. They consider that the depth of immersion the player feels within the game will influence how far it is able to meet other core requirements magnifying or reducing the effect of meeting other pre-requisites for flow.

The analysis, in section 5.4, suggested that there is some correlation between immersive properties and the layers of response that were identified by Norman (2005). His categories are temporal in their nature, from immediate ‘visceral’ response to an ongoing ‘behavioural’ response during interaction and a ‘reflective’ response influenced by previous experience and memories. However, it is possible that these conclusions were biased by the fact that the research was prompted by the experience map that included Norman’s categories of response. Considering the work of other experts on immersion sheds light on these concerns.

Ermi and Mayra (2005) also identify three components to immersion in their model of a game experience: sensory, challenge-based and imaginative immersion. Sensory immersion is the extent to which the surface features of a game have a perceptual impact on the user and correlates exactly with ‘visceral’ response, defined by Norman. Their work was based on screen-based video games and this was intended to relate to the graphics, sound and other media, yet can also be related to sensory experiences within the real environment. Challenge-based immersion refers to involvement in the interactive aspects of the game that are needed to meet the challenges the game poses. This could again refer to the activities in the natural environment or navigating the screen-based interface. Other researchers regard an experience as formed through a process of interaction over time, with personal, social and physical components. (Falk, 2000; Sharples, 2010) and therefore an
ideal experience would depend on feelings of engagement *during* a process. This definition bears considerable resemblance to the ‘behavioural’ aspect of response described by Norman and reinforces its significance as a category of immersion.

Ermi and Mayra’s third category, imaginative immersion, refers to the fantasy world created through the game narrative where players effectively ‘lose themselves’. Ritchie et al. (2014), Rigby and Ryan (2012) and Freeman (2003) also refer to the immersive properties of a narrative within a game and how it can feel like we are a part of the imaginary world it creates and are connected with meeting emotional needs, but their capacity to allow players to escape to a different world is clearly also fundamental to immersion. For PBMGs the narrative can also play a key role in connecting elements of play in the landscape with the overall game roles and the virtual world. Norman’s work does not relate specifically to games and the interfaces he generally refers to do not always have a fantasy element to them. Imaginative immersion should, therefore, be considered as a further category.

The Ermi and Mayra model does not explicitly include a ‘reflective’ component. Indeed, it could appear contradictory, as immersion tends to refer to feelings in the present moment. However, they also note that motivational components, desires, and anticipations should be considered in light of previous experiences. Rigby and Ryan (2011) also discuss how the immersive properties of a story will depend on whether it is a ‘good’ story. Judgement of this may be based on certain objective factors, such as how well it is expressed or its structure. However, there will also be a subjective component related, to the perspective and previous experiences of the reader. According to Norman (2005), such preferences are a ‘reflective’ response.

The child’s previous experience of a natural environment and predisposition towards can also be considered in this light. A possible further component to flow is, therefore, why a person might be drawn to a particular activity in the first place: considering reflective response is one approach to addressing this. Parts of the natural world were more meaningful to children, through their
metaphorical relationships and symbolism, which are a reflective response. It is, therefore, suggested that there should be a reflective aspect included in definitions of immersion, as it is an influence on current feelings towards a subject.

Physical engagement with a landscape has not been included in any previous models of immersion for games. This is understandable, since studies were generally related to screen-based versions. For certain activities, drawn from the work of nature experts, such as the player being asked to dip their hands into a pond, the children’s hands are actually physically immersed. Similarly, the purpose of the game is to locate the player physically in a natural environment. Therefore, physical immersion is also included in the diagram that illustrates the nature of immersion, shown in Figure 5.2.

![Diagram of different aspects of immersion](image)

**Figure 5.2 Proposal for different aspects of Immersion for a PBMG.**

In practice, a broader study on immersion and its influences for PBMGs would be useful to provide more evidence for this model. However, this was outside of the scope of this project, which was to adapt the basic pre-requisites for flow. Nevertheless, the model shown has been considered from the perspective of ‘how to design PBMGs to support immersion’ and as such it provides a useful starting point for considering factors that do not fall into an obvious category of a flow pre-requisite.
5.5.2. Feedback and Feedforward.

The original Flow model includes Feedback as a pre-requisite, this concept is also discussed by Norman as being an important principle for interaction design. Users need to know what they have achieved and if they have made the correct choices, often to be able to proceed at a practical level. There is also an emotional component to this, as a sense of satisfaction can be promoted in knowing achievements have been made. This is important for games, where being rewarded for achievement is a necessary part of the motivation for play.

However, Norman also discusses the concept of ‘feedforward’ and this is not mentioned in previous flow models. Throughout this research, the role of affordance in meeting the requirements for an optimal experience has emerged. Affordances can suggest actions to direct play, both in the landscape (noting the findings for photography and wayfinding during this research) and within the game app (evidenced by media signifiers on the map and used for instructions in this research). Feedforward can play a role in optimising levels of challenge by providing signifiers and clues to direct players, contributing to playability and pragmatic aspects of play. It can also be part of motivating players to overcome challenges, according to Fjortoft (Fjortoft, 2004). Feedforward could therefore be seen as a necessary part of the communication between elements of the game and the player. The diagram in Figure 5-3 illustrates some of the key influences of both feedback and feedforward for key game dimensions.
Chapter 5: Analysis of Results

Feedforward can suggest actions, feedback can communicate the results of these actions and, as such both elements are related to most player interactions. A consequence of the findings in this research was to conclude that both concepts, feedforward and feedback, are the means through which the other flow pre-requisites support flow. For example: How can clear goals be communicated and progress towards them? How can concentration be improved by balancing attention across worlds? For each of these questions, the answer to achieving them involves the use of feedforward to project what actions are possible and subsequently including feedback to tell the what actions were achieved.
5.5.3. Relatedness

During this investigation, the concept of ‘relatedness’ has arisen frequently, through the addition of friends or family in game stories and the evidence that emerged points to this being important for children. It was one of the three key emotional needs introduced by Rigby and Ryan (2011).

Csikszentmihalyi (2002) discusses relationships with others and suggests that wishing to feel connected can be a primary driver in most people’s lives. He also suggests, however, that other people can both help or detract from the flow state. The relational aspect is therefore not usually considered a critical component of flow and was not included in the original flow model interpreted for games. However, for PBMGs and particularly the case under study, engagement with the game is heavily influenced by relationships with characters in the game and also the wildlife found in the physical world. Therefore, it is proposed that ‘relatedness’ is added to the flow model. An issue for further research is exactly how far the concept of relatedness should extend to inanimate elements of a PBMG. Extrapolating Norman’s theory, a person could also be described as having a ‘relationship’ with activities, objects or ideas. When describing the flow state, Csikszentmihalyi describes musicians getting carried away with their piano, or artists at one with their paintings. In a sense the process of interaction with the instrument or artefact substitutes for engagement with other beings. However, for now the key aim of this project is to encourage a stronger connection to nature and place the child ‘in a relationship’ with it, it would therefore be an omission not to include relatedness, in terms of real or virtual characters or relatedness to the environment and its features.

The integration of these adaptations into the revised flow model is shown in Figure 5-4. The original prerequisites, ‘Appropriate Levels of Challenge’, ‘Clear Goals’; ‘Concentration (Attention)’ and ‘Control’ are included alongside the newly added Relatedness. Feedback (in the original model) and Feedforward (a newly added term), however, are considered a mechanism through which all of the other pre-requisites for flow could be met. They are therefore visualised as a series of membranes between the central focus, which is a state of
immersion and the pre-requisites that lead to it.

5.5.4. Summary
This chapter considered the collated guidelines that support pre-requisites for a state of flow in a PBMG and the consequences for re-modelling flow or immersion. The final chapter will consider how the primary research questions were answered during this research.

Figure 5-4 Proposed flow model for PBMGs.
Chapter 6: Conclusions

6.1 Introduction

In the first chapter, I explained that one of the key aims of the project was to understand how we can leverage the power of games and mobile technology to inspire a meaningful connection between people and places. Consequently, this thesis considered the prerequisites for an optimal experience when playing a Place Based Mobile Game (PBMG). This was a new term proposed to describe a situated, absolutely positioned Location Based Game that is designed to encourage engagement with a physical environment. This game genre appeared to have the most expressive potential and appropriate characteristics to encourage a relationship with the landscape. Flow theory was considered an ideal theoretical framework to support the project goals, as it aims to define an optimal experience. The case chosen for the study was older children playing in natural environments, a particularly topical and challenging context, addressing a contemporary social issue known as ‘nature deficit disorder’. This also provided a relevant scenario to frame the investigation. The methodology followed a concept-driven design research process, which scrutinised the chosen case in detail using a broad range of methods selected via the Say, Do, Make/Think framework.

6.2 Main research outcomes

An adapted model of flow for PBMGs has been created, alongside a series of design guidelines that can support game development. The process of sifting through characteristics and building on previous definitions to create the term PBMG to describe a situated, absolutely positioned LBMG that can connect players with an environment is normative work that may also be considered useful for research, though difficult to measure in impact, according to Montola (2009). Methodological outputs include the creation of an ‘experience map’ that can prompt design researchers about different areas of consideration for PBMGs and also a new method, using characters and stories (CAS) that can help to reveal the latent needs of children.

The main outcomes and their relation to the areas of study are represented in Figure 6-1. Some of the findings address games situated in any environment...
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(Shown in purple), others apply specifically to the chosen case of natural environments (shown in grey).

6.2.1 Design related outcomes for any PBMG

The newly created model of flow for PBMGs is illustrated in Figure 6-2. It emerged through a ‘bottom up’ process, whereby detailed design guidelines were created, during the investigation of a series of research questions and subsequently categorised against known pre-requisites that can support an ideal experience.

Each phase of the study, starting with the literature review, helped to tie down aspects of a ‘wicked design problem’ as design guidelines were revisited, through an iterative design research process, until they could be finalized, to support the
future design of PBMGs. Studying the game properties in this detailed way allowed greater understanding of how they could meet existing flow pre-requisites, but also how a flow model would need to be adapted to best represent an ideal experience specifically for PBMGs.

There was a focus on including the emotional aspects of play, alongside practical usability considerations, inspired by previous experience-based researchers, such as Shedroff (2001), Jordan (2002), Norman (2005) and Preece (2015). A series of interaction principles, developed by these researchers, were influential in forming initial design guidelines related to this project. The investigation also revealed how a pre-emptive approach to predicting emotional needs for game design can influence the flow pre-requisite of 'control', drawing on the theories of Rigby and Ryan (2011) and others (Freeman, 2003; Yee, 2007; Bateman, 2008; de Winter, 2015). The way literature related to these key areas (and others) influenced the flow model is illustrated through a concept map, in Figure 6-3.

![Figure 6-3: New flow model for PBMG’s and issues that have informed guidelines.](image-url)
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It also became clear, during the project, that the flow state can be considered synonymous with the concept of ‘immersion’ for games, thus, a new model for flow, used in connection with the associated design guidelines can support the design of an immersive game. A tentative proposal to structure the nature of immersion, that could also help to direct designers is shown in Figure 6-4. However, we believe a study more focused on the properties of immersion is required to validate the categories and understand them fully.

![Figure 6-4: Suggested components of Immersion.](image)

For a PBMG, immersion needs to be maintained across both virtual and physical worlds. Concentration is related to attention and found to be a particular important pre-requisite for a flow state in this concern. The flow of a game can be challenged when the player must switch their attention between two different domains during the game play. Issues of balancing attention had been noted by previous researchers (Schwabe & Goth, 2005; Frohberg, 2009; Eliasson et al., 2011; Molloy, 2016), with players generally spending too much time looking at the screen during wayfinding and navigating instructions. A series of design guidelines were created that support these concerns. Planning times when the game should direct attention to the screen or physical world was found to be critical in this respect. Guidelines related to methods and media for managing attention switches were also considered in some detail during phase 4 of the investigation, concluding that AR characters, superimposed on the real world were more immersive.

For the aims of this project, a connection with ‘place’ was a particular requirement, especially when compared to LBMGs such as Pokemon Go! (Das Gupta, 2016). This requires the game to emphasise immersion in the physical
environment more than previously successful games. Design guidelines were created that suggest the inclusion of activities, developed by nature experts, that require high levels of engagement with the landscape, as intermediate game goals, along with reward systems based on natural features. Conversely, design guidelines that improve usability and minimise the effort involved with activities, such as wayfinding and navigating instructions, help to reduce levels of attention to the screen. An innovation, using first person videos that indicate the direction to be taken, necessitated a comparison with the real landscape and is considered a research outcome. It was also noted, through design guidelines that affordances in the landscape could be used as way markers to draw attention back to the physical world.

The use of narrative was also found to support immersion, as Ritchie (2019) suggests, binding together the disparate elements of the game across worlds. Guidelines encourage the use of narrative with an overall game goal that can support key emotional needs that were identified (Rigby & Ryan, 2011), such as competence “Save the forest” or autonomy “Be a detective and discover” to optimize immersion. Intermediate game goals, requiring the child to focus on the real environment, should also be related to the same narrative, whereby it becomes a natural progression to return attention to the virtual world.

Taken together, these research outcomes can inform the design of PBMGs that can help to connect people with places for any purpose. Each pre-requisite for flow, if seen as a contributing factor to game success, is thus broken down into a series of guidelines about how to achieve it. Potential applications vary from encouraging visits to historical sites to enabling communication between people of different demographics or cultures in a specific location. Applying the research outcomes to different scenarios would be an interesting further stage for similar research.

6.2.2 Design related outcomes for the specific context of play

Considering how the properties of a PBMG should meet the specific challenges of older children playing in a natural environment provided a suitable case for this research. The terrain represented a greater level of physical and cognitive
challenge than an urban setting, due to its relative lack of structure or visible landmarks and its undulating and complex nature. Many of the conclusions, however, will apply equally well to ‘easier’ terrain.

The practicalities of play in this environment were understood by working with nature experts. The body of research gathered about play types and emotional needs can also help to indicate relevant content, game goals and activities for those who wish to develop any form of digital activity for a natural environment.

It is therefore concluded that this research should be supportive of addressing issues related to ‘nature deficit disorder’ and the wellbeing of children. Future research would ideally focus on implementing fully working games that can be more enticing and encourage children outdoors.

6.2.3 Issues relating to the Flow model and design guidelines

6.2.3.1 Optimal flow and levels of immersion

It is difficult to measure whether a player is fully immersed or in a ‘flow state’ for a study such as this, it is only possible to observe and record self-reported accounts of how enjoyable or engaging an activity was. However, if the flow state is considered as an ideal, the design guidelines and flow model will almost certainly help to design better, more engaging games. Thus, the flow model and associated guidelines should be helpful to the aims of the game design community. However, as it is not really possible to establish within the remit of this study that children were genuinely in a flow state throughout their game experience, study into the nature of immersion as suggested in the previous section could investigate further.

6.2.3.2 Flow and pedagogical games

It is important to stress that the aims of this project were to produce a ‘hybrid’ game, which addresses both fun and learning. The primary objective was to encourage the audience to attend an environment, through an enticing and enjoyable experience. This was supported by research that indicated a connection with natural environments, providing wellbeing benefits as encouraged by being physically present and interacting with the features found.
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During design research, there was evidence of learning taking place during play, such as children learning the names of plants and the behaviour and habits of creatures. The activities by nature experts, included as intermediate goals, are often designed to introduce particular facts and features to the child. Narratives relating to environmental issues and characters that raise awareness of different species are other possible mechanisms for learning about nature.

However, there are limits to the volume of educational content that can be included without compromising playability and enjoyment. Reading long passages of text, extended activities, or watching long videos would almost certainly impact on the flow of the game. According to educational experts, there is also a reflective component to learning, whereby the individual reflects on their own experience in a self-conscious way. Such activities could be at odds with maintaining a flow state, which requires a ‘loss of self’.

Nevertheless, if the pre-requisites to a flow state are what leads to an engaging and enjoyable game, they must be prioritized for this project. It is suggested that perhaps an educational pack, containing further reflection on learning, or even follow up activities for parents or teachers, could address deeper learning objectives, after the enticement of the game has piqued the child’s interest.

6.2.3.3 Adapting to a context of play

As Czikszentmihalyi, (1990) suggests, optimal flow requires a delicate balance between anxiety and boredom, that can be different for each person. The requirements for this age group of children in this context were investigated thoroughly to attempt to ensure that a game design would meet the needs of the majority. Design guidelines attempted to address a threshold of skill level to optimize this balance as far as possible for the age group, through offering appropriate levels of challenge. There was also an attempt to design the game flexibly, with an array of activities that will meet different preferences or ability and can be engaged with to varied levels of achievement and still meet the game goals. However, it is important to recognize that the needs of every individual cannot be met and that some children may have specific fears, different abilities or other problems that cannot be foreseen. In this sense, design research is
frequently used to establish game success with an audience majority. However, it is also suggested that further research could be conducted that might investigate the creation of games for children who fall outside of the typical levels of ability, including those in wheelchairs.

A caveat to any implied suggestion of simply following the design guidelines for developing future games for a different context also comes from a user-centred design principle that the player’s perspective is always necessary. A chosen audience will have an existing relationship with the context of play which will influence their predisposition towards the experience. It is proposed, therefore, that future investigations should include similar participatory approaches to those that emerged during this research to reveal the specific requirements of the case.

6.3 Methodological outcomes

6.3.1 Experience Map and CAS

In order to understand the pragmatic, emotional and latent needs of children when playing PBMG’s it was necessary to develop new methods and approaches to investigate them. To support a thorough investigation, an ‘Experience Map’ was developed that visually represented game dimensions and likely player response to prompt the research issues being considered, shown in Figure 6-5.

![Figure 6-5: Map of an experience for LBMG's](image-url)
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The map can provide a useful prompt for others conducting participatory or contextual research toward the development of PBMG's for any audience or situation of play.

During the process of working with children, new methods were developed that helped to identify key emotional needs. The Characters and Story method (CAS) was shown to help reveal the latent needs of children, including fears about the environment. This was also shown to be a relevant method for commercial games and research projects that addressed a broad range of different technical products.

When used in combination with Sanders et al. (2002) ‘Say, Do, Make/Think’ framework, these contributions can be helpful as they provide supportive tools and methods that can deepen the quality of findings and ensure rigour during design research for the development of new PBMG’s.

6.3.2 Limitations of the ‘Experience Map’

During this project, the ‘Experience Map’ developed was used to prompt research for a game that would be played by an individual or a small group of children. The influence of social engagement and interaction with other players was not considered, however, for other projects this might be an omission. Transactions with other objects and characters may not fully represent the complexities of co-creating such engagements. In retrospect, the arrows that radiate from the central player to objects, environments and activities, should also perhaps indicate a two-way flow of interaction as both would act upon each other. In order to relate to more complex social structures, future research and developments of the context map could perhaps be related to a range of other social theories. An example might be Actor Network Theory (Latour, 2007), which considers that objects, ideas, processes, and any other relevant factors are seen as just as important in creating social situations as humans.

6.3.3 General limitations of this study

The children recruited for this project were mostly living within the county of Sussex, UK and the observations and participatory activities were conducted in
small groups of them. To mitigate the potential limitations of such a local study, the findings were compared with wider statistical studies in the UK and found to be suitably similar. However, their preferences for natural subjects are still limited to the UK, based on typical indigenous species and terrain. Future research would need to be carried out to understand how the conclusions for question 3 might apply more appropriately for other countries. However, the findings about design guidelines for PBMGs that relate to a range of contexts and the adapted flow model were discussed in terms of international literature and should be relevant more widely.

6.4 Addressing the primary research questions

The primary research question was:

• What are the prerequisites for optimising the experience of playing a PBMG?

Interpreted for this particular case as:

• What are the prerequisites for optimising the experience when older children play a PBMG in a natural environment?

Through the new model of flow, map of the experience and design guidelines general to any scenario, previously described, the overriding question has been addressed for both the general and contextual case.

During the research, in keeping with the iterative nature of methodology, the overriding questions were revisited, to become more detailed versions, which were more appropriate to get to the bottom of the wicked design problem:
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**Question 1:** How can the game be designed to offer appropriate levels of challenge, matching the ability of the audience and minimising superfluous effort, when activity is divided across virtual and physical worlds?

**Question 2:** What are the attributes of the game that can increase volition to overcome challenges, by targeting and addressing the emotional needs of the player.

**Question 3:** What are the attributes of an LBMG that can help to connect people with place (in this case the natural environment)?

The findings towards these questions are discussed in more detail in the following sections.

![Figure 6-7: Theoretical outcomes for this case](image)

### 6.4.1 Question 1

The innate properties of PBMG’s potentially raise the level of challenge they present, by comparison with conventional computer games, threatening a basic pre-requisite for the flow condition. Increased physical and cognitive effort will be required to negotiate both the physical and virtual terrain, thus the significance of the first question:

**Question 1:** How can the game be designed to offer appropriate levels of challenge, matching the ability of the audience and minimising superfluous effort, when activity is divided across virtual and physical worlds?

A series of design guidelines were discovered during this research providing guidance about: timing; duration; suitable locations; health and safety information and accessibility, considering the levels of ability for the audience. Appropriate in-game tasks have been suggested that meet appropriate cognitive and physical difficulty levels. Ensuring that these were clearly communicated, alongside the overall game goals also helped to address levels of challenge (defined as ‘Clear
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Goals’ in the flow model). Consideration of interaction design principles, adapted for this work, alongside the identification of appropriate media also influenced the design guidelines that address playability concerns. Of notable difficulty was the requirement for the player to switch their attention between the physical and virtual game worlds, especially during wayfinding. This can impact on levels of ‘concentration’, also an attribute of a flow state in the original model.

The investigation demonstrated that affordances within the natural world, previously noted to suggest and encourage physical exercise in young people, can also be significant when directing the player. The categorization of affordances to help with design should also be a useful research outcome for others. Affordance, together with the visual signs, or signifiers that communicate them, are described as ‘Feedforward’. Other new techniques discovered, related to the effort of wayfinding, included the innovative use of video to make it more straightforward. The significance of including ‘Feedforward’, alongside ‘Feedback’, which was already included in the original Flow model emerged through this research as a powerful idea. In theory, because the natural world is more difficult to navigate, the solutions would also be apt for easier to navigate urban environments. However, research in urban environments should also be carried out to test the truth of this assumption.

6.4.2 Question 2

Game experts refer to the emotional needs of players as the primary motivational driver for overcoming the challenges of a game (Yee, 2007; Bateman, 2008; McGonigal, 2011; Rigby and Ryan, 2011). This understanding led to the research question:

Question 2: What are the attributes of the game that can increase volition to overcome challenges, by targeting and addressing the emotional needs of the player.

An investigation of the emotional needs of children for this case was carried out through CAS methods, co-designing approaches and testing of prototypes with children. Design guidelines produced through this process addressed their sense of volition to complete the game and how this should be implemented, through the game goals, activities, narrative, characters and content, in answer to this
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question. Key mechanisms for children to address emotional needs were related to enhancing feelings of competence or mastery through the core mechanics and narrative and allowing feelings of independence, exploration and choice. A fuller description of how particular narratives can address emotional needs is given in Chapter 5 and some of the findings are also discussed in terms of connection with place, in the following section.

During the process, it became apparent that the emotional needs identified by Rigby and Ryan (2012) of autonomy and competence were both different facets of the need for control, a pre-requisite for flow (Csikszentmihalyi, 2002). For games, a need for control has also been interpreted as the player being able to direct the course of action in a practical way.

Through many of the stories created by children, the role of friends and family was highlighted, along with home and shelter as supportive mechanisms. This raised awareness of the role of relationships with supportive characters for game success in PBMG’s and this is defined as ‘relatedness’ an identified emotional need by Rigby and Ryan (2012). Csikszentmihalyi’s original text discusses the importance of relationships with people, however, others can either help or disturb the process of flow, particularly concentration.

Attempting to include game mechanisms that involve meeting other players, particularly strangers, as is the case with Pokemon Go! were ruled out for safety reasons. For games, however, relatedness could also be interpreted through relationships with virtual game characters, where they take on human qualities, despite being portrayed as animals, or parts of the environment. This led to subsequent modification of the flow model, to include ‘relatedness’ as a concept leading to flow, due to its importance with children.

Feedback and feedforward again both emerge as significant for interaction between the game, landscape and the child when considering emotional considerations of the game. For example, feedforward may take the form of a video of an endangered animal asking the player to help them through actions in the real world. Feedback, by contrast, could give positive encouragement as part
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of a reward system for actions carried out. Thus, this research helped to conclude that feedback and feedforward should be considered fundamentally as part of the communication process, the dialogue through which all the other pre-requisites for flow are actioned, rather than as a mutually exclusive flow pre-requisite.

6.4.3 Connection with place

The final, refined, research question was:

*Question 3: What are the attributes of a PBMG that can help to connect people with place (in this case the natural environment)?*

It became clear during this project that a better way to consider a sense of connection with place, is to view the question as ‘how can the game encourage immersion’ in the environment?’. Therefore, the design guidelines that address other flow pre-requisites are part of answering this question, since the concepts of flow and immersion are closely related. For example, the ability to concentrate (can the player concentrate on both a location and also what the game is telling them about it?) is clearly a prerequisite important to maintaining a connection with the real world.

However, more specific design guidelines were discovered during the research that could address the apparent lack of connection young people have with nature. The activities discovered during this study, inspired by nature experts were designed to encourage immersion, through a range of play types; whether through sensory play, physical interaction or increasing knowledge of plants and animals. Including them in the game as intermediate game goals is an obvious way to encourage a connection with the environment.

A game narrative was also found to increase immersion, discussed previously reinforcing the views of researchers. In this context, relating the narrative to natural world themes and connecting the intermediate game goals also supported immersion in nature (Ardito, 2010; Ritchie, 2014). Narratives could include real concerns, such as environmental issues, the healing properties of plants or the plight of animals finding food. When investigating emotional needs, this research uncovered that children enjoyed scenarios where objects, places and elements from the natural world become agents for game success and could be a potential
mechanism for increasing their respect for the environment. For example, ‘power-ups’ are a common game feature but obtaining ‘slime-power’ within the narrative of the game, when encountering a real slug, can make them feel more connected to the subject. Mechanisms for overcoming latent fears of the environment through the game were also revealed as important.

The techniques and guidelines discovered are, in many cases, transferable to other environments and audiences; in general, the objects and locations within the game can use similar approaches to address key emotional needs for autonomy, relatedness, or control, as a key part of the game play.

The children throughout the design research investigations were enthusiastic and helpful game players (and game makers), suggesting that PBMG’s have the capacity to capture the attention and imagination of children for this context. This research has therefore demonstrated the potential of PBMG’s to encourage outdoor play in these environments and the inclusion of children in the process further guaranteed their success with the audience. Such experiences, through mobile technology, have the potential to be harnessed in mitigation of ‘nature deficit disorder’.

6.4.4 Suggested Future Research.

6.4.4.1 Concept prototypes vs. a finished game

The specific findings for older children playing outdoors in nature and creation of prototype PBMG’s effectively form a detailed and validated design brief to create games that could help to counteract nature deficit disorder. Ideally, from a personal perspective, the next phase would be to implement the research through a finalised, sustainable and professional game production, drawing on the design guidelines and conceptual designs created by children to make enticing games situated in natural locations. This could be followed by a more empirical approach to evaluating its efficacy for encouraging children to visit such locations, with larger groups of children. A larger statistical study, to measure enjoyment, sense of volition and educational consequences would be an ideal further stage of this research.
6.4.4.2 Social Engagement

A limit to this research in regard to levels of social engagement was described in section 4.1.1.4. The study has focused on creating an ideal experience for the game, playing as an individual or in small groups, but an analysis of playing with others was not included. It was suggested that further research could be performed to introduce and evaluate these aspects further.

However, for this project, social engagement was considered secondary to the individual’s relationship with the natural environment and those features of the game that support a connection with it. During the project, it became clear that the player’s existing relationship and pre-disposition to the game attributes is important for flow. Players usually relate to particular places, activities, narratives and graphical styles that can lure them towards playing and continuing the game. A possible perspective on this is that the concept of relationships, expanded to include objects and environments in the world around us, perhaps replaces social engagement with humans, when in a flow state. When a musician is playing a violin, the interaction between the player and the instrument effectively represents a conversation between the two. Cooper (2003) suggests that when we engage with technology, we have a relationship with the digital interface, as though it were another human being. Further research, including social theories, such as Actor Network Theory (Latour, 2007) could clarify how such relationships are supportive to flow and ‘relatedness’.

6.4.4.3 Game attributes

Within the scope of this research, acceptable themes for the game, such as character designs and animations were considered. Media that helped with wayfinding was also investigated to ensure the threshold of playability was appropriate. However, these areas could be further explored to experiment with further options, should they be of particular interest to researchers. A linear sequence of activities was seen to be preferred over a random sequence, in phase 2, which was counter to expectations, the full reasoning for this could also be studied.
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6.4.4.4 Children with different levels of ability
Currently this research has been based on the needs of children with typical levels of physical and cognitive ability for their developmental age, discussed through the work of researchers in chapter section 2.3.7.1. This was due to the complex and demanding terrain typically found in natural environments and the challenges inherent in a PBMG. However, alternative game versions could be investigated that address the requirements of wheel chair users or those that have different levels of physical or cognitive ability.

6.4.4.5 Comparing different contexts
On a broader scale, PBMG research is still in its infancy, relatively speaking and is a complex field with great potential to enhance the physical world. Ejising-Duun (2011) stated that understanding requirements across different applications and contexts is part of the maturation of a research field and an emergent need for this activity. At the time of writing, this is still an ongoing requirement. The full potential of these games is still not fully understood, they could possibly draw people away from indoor screens, provide vital information in situ, enable communication across different cultures and communities and be deployed in locations across the world. Similar design research processes that involve the chosen audience will help to create context specific guidelines to guide their production.

6.4.4.6 Educational goals
It was found that there are limits to the amount of education content that could be included, while maintaining engagement and the flow of the game, discussed in section 4.1.1.2. Self-conscious reflection is not an element of flow, which promotes a disconnection from ‘self’. However, natural science is a part of the national curriculum in the UK, at the time of writing. It was suggested that the game could be accompanied by an educational pack to encourage reflective practices after playing. Further research could consider such a course of action and evaluate the success of using a PBMG to motivate young people towards related curricular activities.
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6.4.4.7 Technology advancement

Finally, advances in AR technology along with other technologies for recognising objects, in both urban and natural settings, continue to be made, blurring the boundaries between real and virtual worlds. Future research projects that expand on the results of this project and investigate the potential of new scientific breakthroughs, offer another potential way forward in connecting people with places through PBMGs.

6.5 Final Summary

This study has resulted in research outcomes, in the form of a new flow model for PBMGs and associated design guidelines, that should be valuable for the work of future game designers. Though there are some limitations, for certain contexts, in adopting the concept of ‘flow’ fully, the model will certainly provide a useful prompt to create more engaging and enjoyable games. The guidelines can provoke the design of games that will immerse the player more fully, in both a physical and virtual environment. The work has considered how to balance the attention of the individual and make focus changes more seamless in their nature. It has also considered appropriate levels of challenge and how to increase volition to overcome such challenges. Techniques discovered, that promote interaction with the landscape, through activities and game goals, can augment experiences in the real world and also make them more immersive. Methods for working with children and approaches to design research have also been addressed that can help to create a best ‘fit’ for games developed for different contexts and possibly address a range of social issues.

I am particularly hopeful that PBMGs, for natural environments, will be instrumental in attempting to overcome ‘nature deficit disorder’. This has been a particular concern of mine and it was a pleasure to contribute to research in this area.
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(Koles and Nagy, 2016)
Appendix: Connecting People and Nature: Designing Place Based Mobile Games: Optimising the Experience for Older Children in Natural Environments

Catherine Grundy, PhD Thesis 2019
8.1 Playing LBMG Apps

8.1.1 “Treasure Hunt’ style Apps

Sussex Wildlife Trust App.

Sussex Wildlife Trust created an App, as part of a research project, representing a trail guide, for their Woods Mill nature reserve. The App features multimedia hotspots revealing images, video and audio clips of a particular habitat or species at specific locations using GPS. At each point, wildlife knowledge is tested with quiz questions; it also indicated possible wildlife that could be found there. Maps are downloaded directly to the phone so signal issues are reduced. An interesting feature is that content changes during different seasons. There is no overall goal, however or reward system. I used the App on location during spring 2013 and subsequently held a semi-structured interview with the developer. The feedback to the Trust from visitors indicated that it did augment knowledge of the habitat being observed and the app had been downloaded for use by a high proportion of visitors. However, I noted first hand, that way-finding and necessary interaction with the screen inevitably detracted from the experience of being in the natural environment as my attention was directed away from it. This supported points made through the literature that emphasize the need to include activities that interact with the landscape. After visiting a number of points I didn’t feel obligated to continue to all of the available hotspots. This may have been because the experience did not offer any overall rewards for attainment, or feedback about progress, properties associated with promoting flow. Images of creatures were shown, with the suggestion that they could be seen in the kind of habitat being viewed. Mostly they were not actually visible and I found this somewhat disappointing. Therefore, these are points I intend to investigate in my own research relating to the emotional responses of children. This issue of users paying attention to the
virtual vs. physical space is one that is considered later when principles relating to location based games are explored.

**Geocaching**

Geo-caching started out as a non-digital, outdoor activity where participants would hide and seek containers, or "caches". These were usually physical containers where the originator would leave what they perceived to be ‘treasure’ or information for others to find. The finder observes and possibly changes the content of the cache and records their visit for the next participant. This process has now been digitized, and several ‘Geocaching’ Apps have been created using GPS to make the finding and hiding more enticing; in this case sometimes the ‘treasure’ is virtual, rather than real. I tried the GroundSpeak Inc. version (GroundSpeak, 2010). Within the App, different points are described to whet the finder’s appetite, with descriptions of levels of difficulty and the kind of experience to be expected. Usually the caches are some distance apart and the aim is to go and find one POI at a time, rather than follow a sequence of activity, though there are versions of Geocaching that are exceptions to this, where points are closer together, or the sequence is followed over several days. When participating in playing the game with my daughter and her friends, aged between 9 and 10, I observed them conduct an enthusiastic mission to find the first cache. Further suggestions to repeat the experience on the same day were not met with the same enthusiasm, however. The activity is shown in the photographs.

![Images from observation of GeoCaching.](image)

**Figure 8.2:** Images from observation of GeoCaching.
Appendix

a goal for outdoor play, guides players to taken note of their environment and has an online community around it, there is also indirect social interaction with other players through leaving messages and objects for them to find. I noted that for the version I played, there was no overarching goal to encourage the repetition of activities, besides a tally of the geocaches found; the ludic qualities of this might add to motivation to continue but could probably be improved upon. I also noted that finding the points using GPS was occasionally somewhat tiresome as the cache and POI require fairly accurate locating. Elements of ‘way finding’ and POI recognition upon arrival could be improved upon for children, for whom map reading is not second nature. Geocache research has supported the notion that unintended, informal learning can occur as a result of interacting with the environment and using digital resources at the points of interest (POI).

Invisible Buildings- Locomatrix

Locomatrix, (Vahrman, 2011) are a Location Based Games company directed by Richard Vahrman; they have developed an array of different LBG’s, including Fruit Farmer and Invisible Buildings. The latter simulates archaeological processes and is themed around the ‘Time Team’ TV program that popularized the activity; the cast are shown to the left of figure 8, it was used in schools to enthuse children about history. A later instance of this was developed and staged at an event at Lewes Priory in March 2016 to get feedback from local people about their game, which I joined in with. The game had several levels, these involved finding specific GPS points where ‘treasure’ was hidden, picking up objects and dragging them to specific locations like a jigsaw (shown in the right hand image of Figure 8); a simulation of the process of geophysical investigations to find underground buildings (figure 9) and a virtual reality simulation of the building discovered. The use of characters in the game made the activities more appealing to children, for
example an owl that flapped to signify when they were closer to treasure. A perceived weakness of the game was the heavy reliance on GPS accuracy, for example it was practically impossible to pick up some of the objects shown in the right hand screen shot of Figure 8; during game play they appeared to be beyond the boundary of the field the activity was located in.

Figure 8.1. Invisible Buildings “geophys” simulation

The simulation of doing ‘geo-phys’ where a scanner reveals ancient underground buildings was also difficult to follow due to the inaccuracies with GPS. I had to follow a relatively exacting line of coordinates to discover the hidden ‘walls’ of a virtual building and reveal its outline on screen. The activity seemed to depend on precise positioning that the GPS could not follow accurately enough and the feedback for what was achieved was somewhat random, this was in my opinion but also particularly that of my less patient daughter of 11. This is a ‘follow the path’ game pattern and demonstrates its heavy reliance on the accuracy of GPS technology.

Pokemon Go

I could not study the appeal of LBMG’s without playing the new game sensation, Pokemon Go. Anil das Gupta, a writer for Gamasutra, a popular gamers blog says: “In the rare case that you’ve been living under a rock for the last month, you’ll be aware of the cultural phenomenon that is Pokémon GO! A cross between an augmented reality game and an alternate reality game developed by Niantic, published by The Pokémon Company and partially funded by Nintendo.” It is not popular with everyone, however, as it has also been the cause of accidents due to being over immersed in the game world while walking in the real one (Molloy, 2016). The overarching goal for players is to take the role of a Pokémon Trainer and collect a set of "pocket monsters"; this helps to claim particular local
landmarks (called ‘gyms’) from rival teams. The game combines augmented reality to superimpose the cute monsters into real life surroundings.

Within a few minutes of downloading the game, I had created my online identity and captured a ‘Charmander’; this is a typical fictional Pokemon creature that would start my collection. Several other creatures were presented in relatively rapid succession, most likely to entice interaction but also to teach new users how to play. The game allows the player to practice the initial moves to capture the Pokemon. Players can subsequently wander around maps that superimpose onto the real world to seek out other Pokemon to capture. Players in their game role are required to train and battle with the Pocket Monsters they collect, they also nurture and develop them. There are also socially beneficial elements; motivation towards exercising is built in by the promise of hatching a Pokemon Egg. Each egg has a distance to travel which helps to ‘incubate it’ to add a new creature to the collection. When the player has a good stock of trained monsters, they are capable of fighting other players’ Pokemon and taking over local landmarks, or ‘gyms’ on behalf of different colour teams. Gupta describes this gameplay is timeless, addictive and surprisingly deep. The same principles are at the core of a huge brand with movies, toys a hit collectable “top-trumps” style card-game and a TV show watched around the world. This would suggest that the game play resonates with people from a psychological perspective. Later in this thesis, consideration of emotional needs will be reviewed to see if correlations with this
success can be made. There have also been negative reactions however and criticisms of the depth of the narrative behind the concepts, which will be explored later.

I also noticed some of the more negative points about this game, with this announcement on a recent train journey through Preston station warning players of the game to be aware of their surroundings at all times and not to wander onto the tracks.

**GPS Response:**
Detraction from game enjoyment can be caused by sluggish GPS response when way finding, with delayed feedback about walking in a particular direction and its inaccuracies when used to locate real or virtual objects. These problems were discussed through other’s research and experienced first hand with the Geocaching and the Locomatrix game. This led to the conclusion that for children, especially, these factors should be reduced or eliminated where possible. Avoiding game play that depends on accurate positioning should help and objects or locations to be discovered should have an optimized discovery distance that can be investigated through later design research.

**Location and Game Space:**
The games played demonstrated different relationships between location and game space. Geocaching usually exhibits a relatively direct relationship with reality, using a standard ‘Google’ Style map to locate points and POI’s based on real locations with associated descriptions. Inevitably, an increased presence and relationship with the landscape is possible through the game, alongside associated informal learning. However the game’s popularity is relatively low compared with Pokemon Go! where a fantasy game world is superimposed upon reality. An ideal solution could perhaps combine the increased engagement with real world environments with more of the make believe properties of commercially successful games.

The level of fantasy would need to be evaluated against the aims of the game.

In spatial terms, the games played represented considerably different distances to be travelled in the real world, with Geocaching from one to several miles and the Locomatrix game with . There could be one POI, e.g. with Geocaching or
many, as with Locomatrix. To learn about different properties of nature more efficiently suggests that games have several POI’s.

Care should be taken not to make the activity longer than the patience level of children, as witnessed with Geocaching. Way finding between POI will be critical and clear directions are necessary in order to maintain the game progress and avoid distraction from game enjoyment. The sequence of points can be linear or random; the game may depend on visiting some or all of the points, further research during the design phase helps to understand requirements in this area.

Similarly, each game has a different relationship between the experiences that occur and their timing. Some are one off experiences that may be a specific event in time (Locomatrix), others are always ‘on’ in the background (Ingress or Pokemon Go!). Interactions with other players also vary, they may be immediate, for example encounters on the beach when playing Pokemon Go! with other ‘trainers’, or over the longer term, when leaving notes for players during Geocaching (or discussing information later online). Some were events held on a specific date and times, like Locomatrix, others were ‘always on’ like the Pokemon Go! game world. Geocaching requires an investment of time in a concentrated block, Pokemon Go! Allows the player to dip in and out of the experiences as convenient.
Appendix

8.2 Papers Related to the Thesis


Abstract
During a series of workshops with MSc Computer Games Graphics students, we creatively explored three-dimensional visual interpretations of Interaction Principles for an adventure game. The principles were compiled from the work of a range of interaction experts and are usually aimed at improving usability for task-oriented projects. The aim was to see how they might influence the design of the game graphics and how they might impact on making the game fun. There is also a longer-term objective to create a visual library of ideas that provide a reference of graphical solutions for such principles.

Keywords
Games graphics; Interaction Principles,

ACM Classification Keywords
H.5.2 Screen Design, H.1.2 User/Machine Systems, Human Factors, K.8.0 Games.

Introduction
In a previous experiment based at the University of Westminster (London), we considered principles for interaction from a range of sources like Donald Norman, Patrick Jordan and Jakob Nielsen. The aim of the exercise was to review the use of each in terms
of their possible emotional context, and consider how the designers of the graphical content might interpret them. [1] [2] [3] [4] [5]

![Wheel of Interaction Principles interpreted for Games Graphics.](image)

**Fig 1**: Wheel of Interaction Principles interpreted for Games Graphics.

The overriding conclusion was that there was a strong correlation between improving the usability through each of these principles and our feelings and emotional reactions to the interface.

For games this is a more than likely result since the interaction has a direct influence on the playability and therefore the success of the game. Practical exploration of the ideas under discussion was an obvious next stage to the study.

We chose to apply the ideas to Adventure game designs, for reasons given below. Examples of typical adventure games might be Myst [6] or Grim Fandango [7]. For adventure games, the player usually stops to survey a particular scene in more detail than other genres, the play is relatively slow compared with other types, and particularly action based games. This probably means that the design of the environment will have more significance since the player is taking more time to absorb its finer points. It is also the case that the environment and the objects within it provide a good deal of guidance for the player; in fact this could be considered the main theme for the game. The scene gives clues about proposed direction of travel, what a player should do next, what the aims of the game/level/specific puzzle are and so on. The feedback provided about the player’s activities also provides motivation and guidance through the game. These indicators are a fundamental aspect of playing the adventure game; they are also specific cases of the interface communicating to guide the user in 3D. Therefore the genre is an ideal one for the nature of our experiment and interaction principles applied to the 3D design of the scene should directly influence the success of the game.

**Context**

It is only relatively recently that it has become a mainstream activity for HCI specialists, and design researchers to understand the subjective emotional state of the user during interaction. Making people feel good about an experience is a useful aim in itself, but there are also those who consider that making activities more fun will improve usability and communication. [8] For example by improving our ability to concentrate.
Marc Hazzensahl [9] stresses the importance of including studies of cognition alongside emotion. He provides a cautionary message, about considering ‘passion, desire and seduction’ above reason, pointing out that modern Cognitive Psychology regards emotion and cognition as integral parts of each other.

In our opinion, fun can make things usable and using principles of usability can make things fun.

A particular approach of this project was to integrate the strengths of graphic design disciplines i.e. Communication, understanding of audience in terms of designing identity and visual communication with those of HCI and interaction design. Those in the field of HCI have been less inclined to study the visual appearance of the interface, than those from an artistic design background. By contrast, a thorough analysis of interaction studies studied for HCI is not always a prerequisite for the creation of visual aspects of the design, and there are many interesting HCI issues that would inform the design process.

**Design Exploration:**
A series of lectures were given to outline the main principles of interaction. The most significant principles for this exercise were focused on, particularly ‘Engagement’: the ability of the interface to involve the user in the process of use and to keep them interested and informed about what to do next. This can create a state of ‘flow’, which helps to make us feel relaxed and happy. The other related principle is ‘Feedback.” The user should be kept informed about their choices.

The students were free to explore these principles in a graphical style and game theme of their choice.

Investigations of these themes were also broken down into some issues about visual perception, which were considered as devices to explore the design. In particular we used methods of visually guiding the eye, introduced in classic visual communication texts. [10] To aid with engaging and directing players we used contrasting visual elements i.e. in figure 2 below, the moving planetary spheres should be more striking than the background elements due to their colour, movement and form.

![Fig 2. Scene from Adventure game designed by Seth Brown. MSC Graphics Student University of Westminster 2005](image)
items in different places appear connected. This was employed effectively in the example in Fig 3 below.

A series of visual techniques were also explored, including use of affordance to make objects expressive of their use, figure on ground effects to investigate hierarchy of objects, gestalt principles to indicate proximity and others. There were many interesting interpretations of the principles using these methods.

There can be no serious evaluation of the effectiveness of the techniques in making the game fun (or even more usable). This kind of test could not be conclusive without an alternative ‘before and after’ example and the value of doing this is debatable. However on an informal level most agreed that it seemed more fun!

Further work
This is an early stage of exploration. Further work would require a much more thorough investigation of particular principles and the visual devices that exist to express them. It is also necessary to formalize some kind of evaluation of the ideas. It is hoped that contributions to the library (gallery) of visual techniques for improving interaction and the fun of the game can be instigated by cooperation with other institutions and researchers using this paper as a vehicle for discussion.

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Vis-able: Using Visual Communication Techniques to improve Usability

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Abstract. Previous research by the authors established a set of interaction design principles, aimed at creating usable but also enjoyable interfaces. The work outlined in this paper aims to move towards practical interpretation of the ideas and consider visual techniques for realizing goals for game interaction. The study is intended to combine creative Aesthetic and Emotive approaches, commonly associated with Design disciplines, together with ideas originally derived from HCI and usability foundations. Students investigated two particular areas through project work on the MSc in Computer Games Graphics. The resulting interface designs underwent a critique review process and their success in guiding players through an adventure game considered from an emotional and qualitative perspective.

This paper describes a component of a larger project, to make an interactive gallery illustrating ideas that will be an educational tool to improve understanding and inspire students. We review two typical aims for interaction and some examples of visual techniques that may help.

Keywords. Games Art, Educational Tool, Emotive Approaches, Interaction Design, Usability.

1. Introduction

Previously, we considered principles for interaction from a range of sources like Donald Norman, Patrick Jordan and Jakob Nielsen. The aim of the exercise was to review the use of each in terms of their possible emotional context, and consider how the designers of graphical content might interpret them. This was summarized in a paper entitled ‘Go with the Flow or seize Control’ [1] presented at ITI 2004. This work gave us a clearer perspective of what we were aiming for, but did not provide us with practical techniques to help realize ideas and turn principles into design concepts. Our students will make future interfaces a reality and thus it was important to explore ideas in a concrete way and to share experiences and interpretations. The principles can be considered part of a design brief. We attempted to experiment with visual techniques, usually associated with graphical layouts and analyze their potential for helping with interaction goals (for screen based applications) through project work. For example art theorists discuss methods of leading the eye around a composition (using continuity, relative visual weight and so on); these may also be useful for guiding a user around a screen to absorb content in an appropriate sequence. We were exploring the interface’s emotive qualities and, by association their task oriented benefits. It is not, however, the aim of this project to evaluate usability benefits for the screen using any form of empirical testing, as this would require a full contextual understanding of each project. The validity of using each of these visual techniques for a given purpose has already been established elsewhere for graphical information design subjects (e.g Gestalt principles cover Clarity of form), the techniques speak for themselves. Their ability to improve the emotive qualities of a particular interface is subjective, but can be
considered via the critique method we have employed.

1.1 Interactive gallery

One of the long-term aims of this work is to create an interactive visual research resource. This will illustrate the techniques studied and explore their potential application for meeting interaction objectives for a range of different fields. One of the preferred methods of instilling an understanding of theoretical ideas for design students is by example. Examples will be gathered from a range of Artists, Software Applications, Multimedia and other design disciplines. The students will also actively participate by exploring ideas through their own project work and critiquing and developing ideas together that will be added to the interactive gallery. The specific aims for the Interactive Gallery are to:

- Compile a series of useful practical visual techniques that support interaction goals.
- Provide illustrations to make principles more tangible and demonstrate their usefulness.
- Help students draw inspiration from a range of disciplines and sources when applying interaction principles.
- Inspire students to address interaction issues creatively.

They will also conduct their own visual research on the work of others and contribute to the volume of inspirational examples. This should improve their awareness of current practice and also their ability to analyze and reflect on their own work.

However this process will take some time, each are of consideration will be considered a research project in its own right.

1.1 Usability and Enjoyable experiences

Improving the emotive qualities of the interface has been considered for some time, by association, to help with Usability. Experts have known for some time that aesthetically pleasing interface designs are usually perceived as easier to use by onlookers [2]. However, the concrete reasons for a real correlation between attractiveness and Usability are less commonly discussed. For example an interface that is clear and aesthetically elegant will cause less stress on our Cognitive mechanisms and will be easier to absorb.

The relationship between Fun and Usability has also been explored [3]. These works indicate a clear relationship between enjoyment and how easily the interface and its content are interpreted. It is also clear from educational and motivational studies that interfaces that appeal to our emotions in a positive way will help us to concentrate and engage more fully with the task in hand. An attractive appearance is part of the pleasure with which it will be received. Aesthetic approaches have usually been the domain of artists and graphic designers, but associations with improved usability have suggested that greater cross-disciplinary understandings might be ideal. Luke Wroblewski is a successful director of a web design company, in his book [4], written in 2002, he provides useful demonstrations of how visual design, combined with a scientific approach, can lead to more “user-friendly” websites. This paper builds on these themes, experiments with other areas of visual perception and ventures into other disciplines, e.g. Games design. In their paper ‘Visual Techniques for Traditional and Multimedia Layouts, Jean Vanderdonckt and Xavier Gillo (1994) provide a diagrammatic illustration of how concepts from art are interpreted; for example they show ideas of Unity, Active and Passive Layouts and the difference between Continuous and episodic layouts, however the reasons for using them are not explored. they need to be related to aims for interaction and also visually explored to bring the ideas to life.

1.2 Multidisciplinary activity

Interaction design activities have provided unprecedented opportunity for multidisciplinary collaboration, with a fusion of influences from cultural studies, ergonomics, technology, perception, psychology, and the design world leading to increasingly holistic perspectives.
Most credible design projects begin with an analysis of user needs, wants and desires. HCI disciplines have provided an ideal grounding for beginning the process of understanding user requirements. HCI foundations guided our design principles. However, as many screen interfaces, for example commercial web sites, have become less text oriented and more graphical in nature, ideas traditionally associated with design subjects have become more influential in understanding communication. A creative graphical application of interaction principles is paramount.

To explore practical methods of interpreting the aims outlined in our previous paper we focused initially on two principles: creating Flow and Clarity. Clearly these are of importance in maintaining engaging game play. The player needs to quickly interpret screens and needs to remain engaged in the activity. We have then attempted to identify some visual design techniques that might help to meet the aim. Creating a full directory of techniques is like piecing together a jigsaw. Within the scope of this paper it is only possible to illustrate a selection of examples that typically demonstrate the approach taken.

2. Creating Flow

To make using an interface more enjoyable, absorbing and consequently more usable, it has been established that designers should attempt to infuse a sense of ‘flow’, developing an increased feeling of involvement in the process of interaction. [5] If a viewer is introduced to the starting point for interaction and then given a visual guide as to how they should proceed it may help to achieve this aim. We would need to know how to draw attention to a particular area (in art subjects referred to as creating “Emphasis [6]”). We can then use other methods, like creating hierarchies of elements using visual weightings, which might lead the eye encouraging a flow of activity.

Visual guidance is necessary for good game play. During an adventure game, for example, the player needs to be led from one important area of interaction to another, without being obviously aware of it. Techniques can be used to create an impact for an area we want the player to head towards. We can consider how the elements of the scene and ideas about visual connections can help.

2.1 Emphasis

![Figure 1. Using visual elements to draw attention. Adventure game by Seth Brown.](image1)

One way to create emphasis is to use the basic properties of elements; usually curved and organic shapes stand out more than basic horizontal or vertical lines in a composition. This is because they cause more stress to the eye. In the first scene shown, fig. 1 the designer has used the round orbs to attract attention to the task in hand. We can also accent the relative properties of basic shapes using size, colour, boldness, lighting and texture.

![Figure 2. Using light to add visual weight. Adventure Game by Hamish Frater](image2)

In Fig.2 Hamish Frater used light in a particular area of the screen to draw
attention to a puzzle in his adventure game. Contrasts between the area to be noted and the rest of the screen work well and sometimes can sometimes override the natural hierarchy of shapes. If we see an isolated square on an otherwise curvy background, it would stand out the most.

**Figure 3. Leading the eye.**

In the final games example, the student (Hamish Frater for the same game) used the trees to lead the eye through the scene to the large tank at the end.

The tank is also quite a striking object; it uses a diagonal, with stronger contrast against the background than the mountains to draw the eye.

### 3. Readability and Clarity

A straightforward example is the Interaction principle that page designs should be clear and readable. Creating an artifact that presents the user with an uncluttered interface is a commonly cited design goal and forms one of the interaction principles [1]. To make something relatively pure in its presentation usually benefits the design from the perspective of its appearance and also its ability to be interpreted. We can describe this as an aim to create ‘clarity’ in its form. This is an example of how a connection between Usability and Beauty can be made.

For readable screen designs, it will be important that viewers can identify the item they are searching for without interference from other objects. The more clarity and simplicity the design has in its form the more likely this is to happen. For an artist, it is accepted that a visual composition will be more attractive and restful to the eye if it retains clarity through its design. The world around us is a complex place, full of a multitude of objects projecting different, often conflicting messages that seem to be vying for our attention and mental 'space'. Often the key to an elegant design is to avoid over loading our sensory mechanisms in a similar way.

But what methods can be used to achieve this? It is not always possible to remove content or functions. Other HCI design directives indicate that designers should make explicit and visible all of the available choices and required information for the user [7] Therefore we need to find clever techniques to make interfaces easier on the eye.

There are some useful practical techniques employed by many screen designers For example:

- Hiding elements that are not needed until the moment that they may be required; methods include using rollovers or unveiling information over time with animation among others,
- Formatting text into readable chunks,
- Including an appropriate combination of different media so that we do not overload a particular area of the brain.
- Avoiding elements that distract our attention when it’s not appropriate, like moving or blinking objects, unnecessary sound and interference from backgrounds.

It is equally important that good Visual layout principles are adhered to:

- If text, images and other content are properly aligned there will be less mental load.
- Ideal proportions remove confusion from our perceptory mechanisms
- Sufficient white space allows our brain to rest.

Another good way, that we will consider in more detail is that of creating Unity and Harmonic repetition.

### 3.1 Unity vs. Distinction.
When considering a design, random shapes have a jarring effect on our perceptive mechanisms. Creating similarity between objects using visual elements, colour, texture, size and attitude can help to improve design clarity; this is known as promoting Unity. The principle of Unity can also be considered in terms of making several objects appear to be of one piece using aspects of form or colour. In this sense they can be bound together and seen as a whole composition, reducing the apparent number of things that must be processed by our brains.

Repetition of similar elements, especially at harmonic intervals is very pleasing to the eye because it reduces the complexity of vision. This is because we take in a new form only once and then we mentally process that it is repeated.

Figure 5. Interface control representations

Fig: 5. The left hand representation of an interface shows a mismatch of shapes; each different shape may be associated with a different function. The right hand control panel with matching buttons is more restful to the eye, but different functions would be harder to distinguish.

This simple example illustrates a dilemma for developers attempting to maximize usability. On most occasions differentiation of different functions, areas of the screen, or controls is a good idea, and therefore some kind of visual distinction will be required. The relationship between interface elements, and the degree to which they appear unified or different, depends on the context. Effective design is frequently a matter of compromise, a balance between competing goals and objectives. Successful graphic designs attempt to balance both aims.

In the Virtual Museum of Canada [9] there are some examples, illustrating these points.

Figure 6. Virtual museum ‘gateway’

The primary links to different exhibitions on this introductory screen Fig. 6 are distinctive repeated shapes, the shapes present a unity of form but the user is able to distinguish different exhibitions by colour. The main links are also different to the other functional links, which are largely text labels. The designer has also used proximity to effectively distinguish navigational groups. The archways are also a clever use of semantics, to give added meaning; they are a ‘gateway’ to the exhibitions.

The hand drawn screens Fig.7 and Fig.8 are from a section of the same museum.: for Fig.7 the sketched objects are a 3D representation of the linked content. The screen illustrates a way of visually unifying potentially distinct objects by placing them in a common 3D circle. This makes them easier on the eye and the screen subsequently more readable. Fig.8 unifies the already circular links into one larger circle and visually separates them from other navigational elements on the page.
4. Conclusion

The examples chosen for the paper were ones considered successful in helping the interaction goal being considered, during the student group review. It was considered that the project work provided us with a useful set of illustrations of the visual techniques to draw upon when considering interaction principles for emotive (and by association, usability) purposes, since the aim of a game is to feel involved and engaged in the activity of play. The student’s work was a creative exploration of the use of visual techniques and introduced examples that should be beneficial to others. In order to get a good range of ideas for the Interactive Gallery, however, it will be necessary to make the scope of the project broader, including a range of disciplines and approaches. We will be seeking partners to continue the project and suitable funding for its launch on a larger scale.

5. References


ABSTRACT
This paper describes a proposed new method for helping to understand the emotional requirements of children during the conceptual phase of designing an interface. The approach may be particularly useful where the feelings of the child are critical, but are difficult to investigate; for example when the issues are sensitive and may provoke emotional responses. Here we explore an approach that draws on the social agency that characters can provide to help the young user articulate their opinion. Children were asked to create fictitious cartoon ‘personalities’ that have desired attributes, personal qualities and behaviors that are relevant to a given scenario. Subsequently this influenced the conceptualization of a product under development for the context defined. The devices were being developed for final major projects across both the University of Brighton and the University of Sussex Product Design departments. Character design was found to be an engaging activity for the children, with a tangible outcome that can facilitate communication between the designer and pupil. It also provides a relatively sensitive method for getting information about the youngster’s feelings through the dialogue that took place. This forms part of a larger study for a PhD thesis based on designing for children’s emotional needs.

Categories and Subject Descriptors
D.2.10 [Design]: Methodologies

General Terms
Design, Human Factors.

Keywords
Co-Design, Design for Children, Character Design.

1. INTRODUCTION
Those with experience will know that understanding user aspirations and behavior for a given context can be critical to ensuring an effective interface is designed. Different circumstances, human characteristics and experiences are critical factors that influence interaction with a device. When designing for children, involving them as the user in the design process is fundamental to accessing this information. Adult understanding of a child’s world for a particular design scenario is otherwise limited. Research in this area has therefore been extensive. Druin et al., [3] Mazzone et al., [7] Obrist et al., [9] and Vaajakallio et al. [14] have studied the strategic involvement of the child in the design process and influenced the inclusion of co-design for this work. Other influencing factors include previous involvement by the primary author with the commercial application of user-centred methods. Techniques to gain empathy with an audience have been applied during Design practice for some time. Philips [5], IDEO [1] and PDD ltd. [10] are among a range of key proponents. The author was involved with a two year Knowledge Transfer Project with PDD Ltd. [6] based on the inclusion of user input within the constraints of a consultancy environment. This experience indicated that, for small design agencies, time and access to the user place a limit on the activity. This is likely to be more extreme for individuals (including undergraduates). Thus communication during co-design activities should be maximized.

This experiment explores Character Design as a tangible and understandable mechanism for communicating ideas during the co-design process. Characters have been used historically for a range of applications from games to storytelling and as such are engaging subjects for children. It is hoped, therefore, that young people will be familiar with what is required. The character development for these projects is directly relevant to the screen or interface design. However, it is also possible that characters may be used as a talking point for discussing thoughts and feelings related to a design subject more broadly. Medical design for children provides a useful genre to illustrate the benefits of co-design. Where there may be stigma or pain involved in the use of a device, insight into young peoples emotional needs is paramount. However, the information
must be gained in the least upsetting and non-controversial way possible. It may be possible that introducing a third party character diffuses the emotional impact of such investigations as the issue becomes less directly associated with the child themselves. The projects included: a) a blood glucose monitor for young diabetics b) a digital product to encourage children to eat healthily and grow their own and c) a digital device to encourage outdoor play.

The aims for these experiments were to consider the following questions:
- Can children follow a brief to design characters for a given scenario and design context?
- Do they focus on the activity and engage with it?
- Can we get useful data from the child’s design efforts that will inform subsequent product development?
- If the character creation process is used for discussion does it make a bad experience more pleasant to discuss?

2. RATIONALE

2.1 Why focus on Creative Co-Design activity?
Elizabeth Sanders was one of the early pioneers of Co-Design techniques and part of her work while at Sonic Rim was to invent and apply the ‘Say, Do, Make’ model [9]. Sanders’ work provides a semantic and practical categorization of the variety of methods available to study a user. ‘Say’ represents techniques that explore verbal information gathering, for example through questionnaires and interviews. These methods” are useful for getting an idea of what people can and want to tell you in words, but they can be limited in predictive terms. ‘Do’ represents observational techniques, like Video ethnography. These are useful but in many cases quite time consuming, often requiring extensive note taking, editing and analysis. Make describes more projective methods that involve creative techniques with the user.

One of the primary purposes of these methods is to find the best design solution possible for a particular audience and to be able to predict new design directions. However, according to Obrist, M et al. [9] “There is still a lack of profound knowledge of how to involve children in the different stages of a product development; in particular the early stages of conceptual design”. This project is an attempt to investigate one such method. There are good arguments for applying each of the Say, Do, Make tools in different situations. In the case of children, there are reasons why the Make activities can be particularly appropriate.

2.2 Children as Design Partners
One of the more obvious reasons why ‘Say’ tools are impractical for younger children is their relative inability to verbalize responses. Methods that rely on description and memory are less likely to yield fruitful results. ‘Do’ tools are based on the observations of the design researcher and therefore a certain amount of interpretation is required. This may be fine when addressing an adult audience, where a similar level of cognition occurs. However, a child’s world seen through adult eyes is open to misinterpretation.

Of the three approaches the ‘Make’ tools fit with a child’s ability most successfully. Despite some scepticism, Garzotto [4] suggests that beyond the traditional roles of children as users and informants, they can be Design Partners. Alison Druin is also a proponent of including children as designers through ‘Cooperative Inquiry’[3]. Creative activities rely less on language and memory, which are underdeveloped skills in early childhood: “Creative thinking in all fields occurs pre-verbally, before logic or linguistics comes into play, manifesting itself through emotions, intuitions, images and bodily feelings.” [12] Creative activities appeal to a child’s imagination and this is one of their main assets, according to Vaajakallio et al. [14] Thus creative exploration forms a starting point for investigations.

3. CHARACTER DESIGN
The reasons for selecting Character Designing for the activities are discussed below.

3.1 Characters are Fun
Mazzone et al. [7] alongside others [11] have found that fun is an important issue when dealing with children. This extends to the methods used for designing so that they can be as engaging as possible. Character design is an activity that children are familiar with, through story creation and other typical classroom activity and one that they appear to enjoy.

3.2 Attachment to Characters
Children love Characters, according to many successful toy designers and film-makers [2] Some psychologists suggest that affection for characters is a natural part of the separation process, allowing children to focus elsewhere in their relationships, beyond the parent bond and be more independent. This could explain children’s excitement over Dora the explorer and Thomas the Tank Engine, besides their apparently likeable qualities.

3.3 Characters have personalities like People and Products
Characters are a useful conduit for discussion because characters can have personalities, behaviors, emotions; likes and dislikes just like their human or animal equivalents. The co-design work done by others, previously described, includes the use of ‘make’ tool kits, which are usually random elements put together to allow easy creation of simulated objects without dictating the results. See Sanders [13] for a range of examples. It appears from the work of some researchers that the actual designed outcomes are less significant than the expression of thoughts and feelings during the co-design process. The experiments by Vaajakallio et al., [14] which include children, suggest that when people build design artefacts together, ideation, negotiation and justification take place during the process. In fact, they regard co-design as a collaborative generative activity that aims at gaining information more than a fixed design opinion. If the design activity helps to generate a discussion between participants of different ages then perhaps a character design could be just as helpful.

3.4 Characters as mediators for emotion

Psychologists, working with traumatized children, sometimes use an inanimate object like a teddy bear or a doll to allow the child to communicate about upsetting events in a non-verbal way. The object acts a prop, to help where language may be limited. The third party character also helps in an emotional sense as the child is talking about events that happen to the teddy or the doll, which may make it easier to open up and talk about the problem. In a sense the character design activity for this co-design project helps with dialogue too, it may also make it less traumatic to consider the more sensitive areas for designing like blood testing.

3.5 Technology has a Character

For computing and devices where characters form an interface to interact with technology or converse with, characters are sometimes described as Embodied Agents. Work on social interfaces by Clifford Nass and Byron Reeves [8] at Stanford's Center for the Study of Language and Information revealed that people treat their technology as people - as if they possessed reason, feelings, and so on. People also treat pictures on screens as real objects, rather than as representations of real objects. This raises the question as to whether creating a representative character for a device might in some ways help with designing the personality of the product in an more metaphorical and abstracted sense. However, more work is needed to establish the truth of this assertion.

4. METHOD AND RESULTS

Experimentation for this study was carried out via the work of three final major project students studying for a BSc. in Product Design at either the University of Brighton or the University of Sussex. All of the students needed to investigate children’s requirements to inspire new concepts for their products. In each case, their co-designers were a class of 30 primary school children at St Andrews C of E Primary School, Hove. The studies were carried out within the classroom environment. Both the tutor (the primary author) and the student were involved with introducing each project brief and to help with directing activities and discussions with children. The pupil’s usual teacher and a classroom assistant were also participants in discussing work with the children. This represented approximately one adult per table of 7 to 8 children. Videotaping was unfortunately not possible for ethical reasons, however some photographs were taken with consent. A selection of children and the class teacher were interviewed after the event to review enjoyment and engagement with the activity. Project 1 was conducted in 2011. Project 2 and 3 were investigated during the same classroom session in 2012.

4.1 Project 1: Diabetes Blood Sugar Monitor

![Figure 1. Typical Pupil Designs]
Bahar Mayahadin graduated from the University of Sussex in 2011. Her major project related to the design of products for children diagnosed with diabetes. The pupils were aged between 7 and 8, an age when children can potentially be diagnosed. She was trying to understand how they might feel about having to prick themselves when testing their blood to monitor glucose. Though none of the pupils have diabetes, it was considered important to include a child’s view. Bahar intended to design a device that would make testing more palatable through engagement with an on-screen character. The class were asked to create characters that react when they get the sample and to describe the character’s behavior. The student and tutor also noted the results of surrounding discussions. The results of the work were subsequently analyzed and an interface for a device similar to a game console was developed.

4.2 Project 1: Results
The briefing phase of the event took 15 minutes, the design phase 40 minutes. Some of the more interesting responses to the character design and behavior brief included: For the female pupils: a girl or a fairy who grew wings and could fly (this concept appeared twice); an avatar who got really fit and ran around a gym circuit; a horse that became happy and started trotting; a girl who falls in love and hearts appear. For the boys: a character that became super magnetic; a monster that could breathe fire; and a character that broke wind or burped. Some of the results are shown in Figure 1. Bahar chose to implement the ‘avatar in the gym’ solution for her major project, and thus the children were influential in deciding the specifics of the game. This idea seemed to her to be the most likely to appeal to the widest boy/girl audience. However, this was still conceptual and the results were not made into a working model or tested. She also used one of the bird characters as a logo for her work. The creativity of the children was a positive influence on her project. She also used the conversations around the subject to gain insight into the children's feelings. Some of the girls wanted to refer to the blood as ‘cranberry juice’ to make the idea more pleasant, for example.

4.3 Project 2: Growing Kit
Sam Hancock, a final year student in 2012, was designing a kit to encourage children to grow their own vegetables and engage with healthy eating. This includes a digital device that monitors a plant being grown and also a receiver that includes a ‘Tamagochi’ style game related to their plant. He asked the children to design a character that represented a vegetable and also what they would look like when they have grown. The pupils were also asked to consider how they might behave. The timings and other parameters were the same as the first project.

4.4 Results: Project 2
Several children sketched the changing vegetables as though they had human growth characteristics, for example a ‘baby’ carrot would become a more grown up ‘kid’ carrot. Over half of the children designed vegetables that develop ‘super powers’ as they grow and have particular attributes depending on their nature.

For example the mature carrot develops super night vision or uses its greenery as a lasso. Other characters included a watermelon that had ‘tsunami’ powers, a lemon that had an acid jet, a pea ‘cannon’ and a strawberry that fired pips. Many other descriptions demonstrated less skill at recognizing witty vegetable properties, however the student found those described useful. Significantly, Sam managed to get the pupils view of ‘eating their greens’ and the information formed a body of research for his project report. His version of the carrot design is shown in Figure 2.

4.5 Project 3: Safe Outdoor Play
This project was introduced to the pupils directly after the Growing Kit. Jonno Battrick is a final year student at the University of Brighton, graduating in 2012. He is designing a game device that encourages outdoor adventure in youngsters while also monitoring their position and making them feel safe away from their parents, it also allows communication between them. The project has been based on evidence that both parents and children feel anxious when children roam and that there are positive advantages in them being able to explore independently. He asked the children to design a character that goes on an adventure, to decide on a place and to think about what they would take with them.
4.6 Project 3: Results
A variety of common environmental terrains were illustrated, for example the dessert, the woods and the beach. Some also created fantasy environments, such as Marshmallow land. Common practical objects were chosen to take on the journey like torches and food. However many also included weapons, and objects like an ‘invisibility cloak’ to keep them safe. This is illustrated in Figure 3. Communication devices were also common.

5. CONCLUSIONS
5.1 Initial Project Questions
The full consequences for each of the design projects require a more detailed account than can be given here, however we can answer our initial questions:

Question 1: Can children follow a brief to design characters for a given scenario? For Project 1, all of the pupils managed to arrive at a character solution, without exception, and the outcome of the drawing activity yielded diverse and creative solutions. Only two of 30 Character Designs were similar, which suggests that most understood the task and did not need to copy ideas from a neighbour. It can certainly be concluded that the pupils were able to follow the brief for each scenario. Communication about a design activity between the student and the pupil has been enabled within a relatively short space of time.

Question 2: Do they focus on the activity and engage with it? The pupils asked a series of questions during each briefing about the activity, which suggests they were motivated in completing the task properly. A high proportion of the group had their hands up and the class teacher had to cut short the questioning for both Projects 2 and 3. For each of the projects the children were attentive and engaged with the activity for 40 minutes. Occasionally they would leave their seats to show their work or to ask more questions. Anecdotally the children seemed very excited. This could have been down to other factors, however, including the fact that we were visitors, or they were doing something different. Experiments to compare other activities would have to be conducted to prove that this was particularly engaging, but it did encourage them to focus.

Question 3: Can we get useful data from the child’s design efforts that will inform subsequent product development? In all three cases, the student used the information to inspire their design. Clearly, the projects chosen were particularly suitable for this approach, due to having characters as part of their screen design. It might be interesting to compare results with projects that use the characters in a more abstract sense to define the nature and personality of a device. The students also felt that the dialogue that was formed around the activity was a useful insight into the thoughts of the children during the process.

5.2 Key Emotional Needs
Some common themes started to appear in the design outcomes. For example, one noticeable feature was the child’s characters becoming ‘super’ or empowered in some way. In Del Vechio’s book: Creating Ever-Cool: A Marketer's Guide to a Kid's Heart [2] he describes how some key emotional needs are represented through play and choice of toys. One example would be a desire for control, frequently identified among young children, because they usually lack control over their lives. This requirement commonly manifests in games of being ‘super’ which would explain some of the character preferences discovered. It would be interesting to do more research on matching common design responses to an understanding of theoretical emotional needs.

5.3 Questions for future research
These include the following:
• Can character designs created by children be translated into more abstract qualities for a developing product's personality?
• Can character design activities be used to identify key emotional needs for a given design context?
Further experimentation will be done in these areas.

6. REFERENCES


CHARACTERS, FUN AND GAMES: CREATING COMMON GROUND BETWEEN STUDENTS AND CHILDREN AS CO-DESIGN PARTNERS.

Catherine Grundy, Richard Morris, Lyn Pemberton

ABSTRACT
Design methods that include the end user of a product in the design process can be useful for undergraduate Product Design projects. These approaches allow a novice designer to gain the perspective of others and to work with them first hand on a problem. When designing for children, this can add valuable insight for design decisions and also provide inspiration around the young person’s world. However there can be difficulties with time constraints and also the ethics of including children in projects that may be stressful. Here we explore a particular approach to Co-design, with students working alongside children to understand more about their emotional needs and aspirations during the creation of character designs for product design applications. The children were asked to create fictitious cartoon characters that have desired attributes, personal qualities and behaviors that relate to a given scenario. Subsequently this influenced the conceptualization of a product under development for the scenario. The devices being conceptualized were for final major projects and included: a) a blood glucose monitor for young diabetics b) a product to encourage children to eat healthily and grow their own c) prosthetic limbs for young amputees. Character design was found to be an enjoyable activity for all, with a tangible outcome that facilitated communication between the student and pupil. It also provides a relatively sensitive method for getting information about the youngster’s feelings and aspirations within the context defined.

Keywords: Co-Design, Design for Children, Character Design, Empathic Design

1 INTRODUCTION
Those with experience will know that understanding user aspirations and behaviors for a given context can be critical to ensuring an effective product is designed. IDEO have been a leading proponent of these approaches [1] Different circumstances, human characteristics, personality traits and experience are critical factors that influence interaction with a device. However, for those relatively new to designing for others, the significance of the task to understand people and the chosen context, in suitable depth, is not always fully apparent. Even professional designers, aware of the motivations for these analyses, may find it difficult to fully empathize with the requirements of others. Novice undergraduate designers can particularly find it difficult to appreciate different lifestyles and preferences to their own and may also lack first hand experience of situations or a context for use. This points to a need to get the user ‘on board’ and involve them directly to get their views.

Consequently Co-creation methods are included in the curriculum for both the University of Sussex and the University of Brighton and their use is encouraged, alongside other user-centred approaches.
Medical design for children provides a useful subject to illustrate the benefits of co-design and represents two of the chosen projects. Where there may be stigma or pain involved in the use of the device, insight into young peoples emotional needs during the encounter is paramount. In this case the view of the ‘other’ is key. However, the information must be gained in the least upsetting and non-controversial way possible especially when dealing with small children.
This approach provides an interesting contrast to a previous experiment where the aim was to expose the design student directly to unpleasant stimuli (albeit briefly) so that they could understand the consequences of designing for the situation. In a previous EPDE paper, [2] the author investigated immersive techniques that allow students to imagine themselves in a particularly panic stricken scenario. We simulated being in a burning building and engaged in role-play activities with existing emergency products so that their interface could subsequently be improved and their use made more intuitive. The investigation used the Creativity Zone, a flexible multimedia space, to create the effect of flames surrounding the subject. Examples included a fire extinguisher, a defibrillator, an emergency radio and an airplane exit. It was agreed that this kind of ‘first person’ event helped them to access the thoughts and feelings that a user might have by ‘maxing up’ the experience. However, by its very nature the activity could be considered traumatic and indeed some opted to leave for the ‘safe zone’ that had been set up externally.

So how can one make talking about a particularly traumatic experience like losing an arm or leg, less traumatic when working with young co-designers? For the student working on prosthetics for young people this is a highly relevant question. Could the answer lie with removing the designer or co-designer one step away from the experience being discussed? This could potentially be done working in the third person through a character or avatar. There are other benefits to using character design as an activity for co-design. It is fun and engaging for both the children and student; it provides a tangible talking point and can be performed quickly and easily. The Character designed also has personality traits and behaviors that can be discussed in relation to the child’s feelings and emotions. Other reasoning is described in section 3.

The Aims for the project, were thus to consider these questions:
- Can pupils follow a brief to design characters for a particular scenario?
- Do they enjoy and engage fully with the activity?
- Can we also get meaningful information about thoughts and feelings related to a scenario for a product design through the character design and its discussion?

Questions for future research include:
- Can the personality of the character design translate into the required character of a product?
- If characters are used as third party agents for the experience does it make a bad experience more pleasant to discuss?

2 CO-DESIGN

2.1 Why Co-Design?
According to Philips, a new focus on a socially oriented approach to Design has been apparent since the turn of the century. [3] With this revolutionary movement, methods from Sociology and Ethnography that gather first hand information about people and behaviors have been adapted and streamlined for design purposes. These are methods that include and emphasize the perspective of a user in the development of a new product or service. If the proposed user is from a different demographic or culture to that of the designer, the methods are probably particularly apt.

Elizabeth Sanders was one of the early pioneers of the techniques and part of her work while at Sonic Rim was to invent and apply the ‘Say, Do, Make’ model. [4] ‘Say’ represents techniques that explore verbal information gathering, for example through questionnaires and interviews. Traditional forms of market research rely on verbal communication between people, i.e., on what people say. The “say methods” are useful for getting an idea of what people can and want to tell you in words, but they can be limited in predictive terms. ‘Do’ represents observational techniques, like Video ethnography. These are useful but in many
cases quite time consuming, often requiring extensive note taking, editing and analysis. **Make** describes more projective methods that involve creative techniques with the user, including co-designing. Sanders’ work provides a semantic and practical categorization of the variety of methods available. One of the primary purposes of these methods is to find the best design solution possible for a particular audience and to be able to predict new themes and design opportunities. To be able to work with children and design for them, in particular, it is necessary to metaphorically enter their domain and grasp their way of understanding issues relevant to them. However, according to Obrist, M et al. [5] “There is still a lack of profound knowledge of how to involve children in the different stages of a product development; in particular the early stages of conceptual design and evaluation” This project is an attempt to investigate one such method. There are good arguments for applying each of the *Say, Do Make* tools that can be defined for a particular design related aim or audience. In this case, there are reasons why the *Make* activities can be particularly appropriate, discussed next.

### 2.2 Children as Design Partners

One of the more obvious reasons why ‘Say’ tools are impractical for younger children is their relative inability to verbalize their responses. Methods that rely on description and memory are less likely to yield fruitful results, in either written or spoken form, than some alternatives. Even innovative methods like ‘Cultural Probes’ and Diaries rely on written statements and they depend on the organizational skills of the individual to a certain extent. ‘Do’ tools are based largely on the observations of the design researcher and therefore a certain amount of interpretation is required. This may be an adequate approach when addressing a new context with an adult audience where a similar level of cognition and understanding occurs. However, a child’s world seen through adult eyes is open to misinterpretation.

Of the three approaches the ‘Make’ tools seem to fit with a child’s ability and engagement most successfully. Despite skepticism in some quarters, Garzotto states that beyond the traditional roles of children as users, testers and informants, children are highly capable of being Design Partners and taking a more creative role. Alison Druin is also a proponent of including children as active designers through a process called ‘Cooperative Inquiry’ This also includes children as observers and researchers of others besides being arbiters in the design decisions. [6]

Creative activities rely less on language and memory, which in early childhood are their less developed skills: “Creative thinking in all fields occurs pre-verbally, before logic or linguistics comes into play, manifesting itself through emotions, intuitions, images and bodily feelings. The resulting ideas can be translated into one or more formal systems of communication such as words, equations, pictures or music or dance only after they are sufficiently developed in their pre-logical forms.” ([7]

Secondly, creative activities appeal to a child’s imagination and this is one of their main assets. Children’s enjoyment of creativity becomes evident through the work of those who experiment with co-design activities. In the words of Vaajakallio et al. [8] ‘Children were motivated or even enthusiastic with the Make tools. Easy configurations and ambiguous shapes that enable various interpretations are the strengths of the make tools. Even though children were slow at building, they did not hesitate in transforming make tools for their own purposes.’ An ideal situation would be a triangulation of information from all three *Say, Do, Make* categories, but within the time constraints of a final year project, creative activities are a useful starting point.

### 3 CHARACTER DESIGN

The reasons for selecting Character Designing for the activities are discussed below. Some projects described here will have virtual characters that effectively form a part of their interface and are part of the interaction concerns that initially triggered the idea.
3.1 Characters are Fun
Mazzone et al. [9] alongside others [10] have found that fun is an important issue when dealing with children. This extends to the methods used for designing so that they can be as engaging as possible. Character design is an activity that children are familiar with, through story creation and other typical classroom activity and one that they appear to enjoy.

3.2 Attachment to Characters
Children love Characters, according to many successful toy designers and film-makers [11]. Some psychologists suggest that affection for characters is a natural part of the separation process, allowing children to focus elsewhere in their relationships, beyond the parent bond and be more independent. This could explain children’s excitement over Dora the explorer and Thomas the Tank Engine, besides their apparently likeable qualities.

3.3 Characters have personalities just like people and products
Characters are a useful conduit for discussion because characters can have personalities, behaviors, emotions, feelings, likes and dislikes just like their human or animal equivalents. The co-design work done by others, previously described, includes the use of ‘make’ tool kits, which are usually random elements put together to allow easy creation of simulated objects without dictating the results. See Sanders [4] for a range of examples. It appears from the work of some researchers that the actual designed outcomes are less significant than the expression of thoughts and feelings during the co-design process. The experiments by Vaajakallio et al., which include children, suggest that when people build design artefacts together, ideation, negotiation and justification take place during the process. In fact, they regard co-design as a collaborative generative activity that aims at gaining information more than a fixed design opinion [8] If the design activity helps to generate a discussion between participants of different ages then perhaps a character design could be just as helpful.

3.4 Technology has a Character
Characters have been used historically for a range of applications from games to story telling. For computing and devices where characters form an interface to interact with technology or converse with, they are sometimes described as Embodied Agents. Work on social interfaces by Clifford Nass and Byron Reeves at Stanford’s Center for the Study of Language and Information revealed that to a considerable extent people treat their technology in the same ways that they treat people - as if they possessed reason, feelings, etc. People also treat pictures on screens as real objects, rather than as representations of real objects.

3.5 Characters as mediators for emotion
Psychologists, working with traumatized children, sometimes use an inanimate object like a teddy bear or a doll to allow the child to communicate about upsetting events in a non-verbal way. The object, in one sense, acts a prop, to help where language may be limited. The third party character also helps in an emotional sense as the child is talking about events that happen to the teddy or the doll which may make it easier to open up and talk about the problem. In a sense the character design activity for this co-design project helps with dialogue too, it may also make it less traumatic to consider the more sensitive areas for designing like prosthetic design. However, more work is needed in this area to establish the truth of this assertion.
4 \hspace{0.5cm} METHOD AND RESULTS

4.1 Project 1: Diabetes Blood Sugar Monitor:

Final year student Bahar graduated from the University of Sussex in 2011. Her major project related to the design of products for children diagnosed with diabetes at a young age. She was trying to understand how young children might feel and in the experiment was considering responses to the idea of sampling and testing their blood to monitor glucose. The ideal was to make the activity more palatable by offering a reward through a game or engagement with an on-screen character. The project was launched within the classroom environment with a group of 30 school pupils at St Andrews C of E Primary in Hove, Sussex. There were aged between 7 and 8, (incidentally an age when children can potentially develop diabetes). The student, alongside the tutor, asked the group to create fictitious cartoon characters that took the blood sample from the child and their behavior on being given the blood. They were asked to focus on a reward for giving the blood. They were also told that they could pretend the blood was cranberry juice if it made the task more pleasant. The pupils had half an hour to draw and describe their creature and how it responded to the blood. Alongside their drawing activity, the pupils were asked to talk about the problem and their reaction to it. The student noted the results of these discussions. The results of the work were subsequently analyzed and an interface for a device similar to a hand held game console was developed. The character designs were used as an influence for some of the motivational games on it.

Results:
The pupils without exception appeared to understand what was asked of them and responded appropriately. There were a large variety of responses to the brief. Example female responses included, after the drink: A girl or a fairy who grew wings and could fly when she was given the ‘cranberry juice’ to drink (this concept appeared twice); an
avatar who got really fit and ran around a gym circuit; a horse that became happy and started trotting; a girl falls in love and hearts appear. For the boys: a character that became super magnetic; a monster that could breath fire; a funny character that broke wind or burped.

Project 2: Growing Kit to encourage healthy eating.

A similar process was repeated with a group of 30 year 3 pupils. Sam Hancock, a current final year student is designing a kit to encourage children to grow their own veg and engage with health eating. It includes a digital device that monitors a plant that is being grown and a monitor that also includes a ‘Tamagochi’ style game related to their plant. He asked the children to design a range of characters that represent friendly vegetable characters and also their archenemies; characters based on typical parasites etc. that were likely to spoil the crops. As they grow, the good characters gain ‘super powers’. The pupils were asked to consider how the characters would appear and behave and also how these would change with development and the nature of their super-powers. Stories about the vegetables were then initiated in order to create storyboards for the game. n.b the final results of this experiment will be available after next Wednesday.

Project 3: Prosthetic Arm

The same process was repeated, but in this event the children were also asked to model their ideal arm.

n.b the results of this experiment will be available after next Wednesday! This can always be removed, however.

4 CONCLUSIONS

The answer to the question initially posed about the pupil’s ability to follow a brief was a resounding ‘yes’ and the results were surprising insightful and imaginative. In casual observation an emphasis on nurturing and the ‘kind’ characters for the female pupils and the ‘superhero’ or evil characters seemed prevalent for the boys. Many of the pupils indicated that they had really enjoyed the session and this was also the feedback through the teacher and it met with our observations too. Clearly, some of the projects chosen may have been particularly suitable for this character design approach, due to having characters as part of their make up. However, the dialogue that was formed around the formation of the creatures was also a useful insight into the thoughts and feelings of the children involved. Their reactions to the scenarios offered and the way they attempted to compensate in their work was very informative. It is suspected that the method could be transferable to the design of non-character based interfaces using the information gained during the process. However more investigation is needed for any conclusion to be reached. An unforeseen result of the first project was the inspiration gained for the logo and semiotic approach of the product. This hints at the abilities of children to inspire their adult co-workers. The enjoyment of the event may signify that character design as a way of eliminating the stressful aspects of
considering traumatic design scenarios for young children. However, this is difficult to prove since we are unlikely to compare it with a stressful version of the activity as a control!

REFERENCES
USING CHARACTER DESIGNS TO REPRESENT EMOTIONAL NEEDS

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ABSTRACT
Cognitive Psychologists have shown that children find it difficult to conceptualize ideas that are abstract in nature (Gelderblom, 2009). Design problems at the beginning of a development process require ‘blue skies’ thinking about new artefacts whose form cannot be pre-defined and therefore may appear intangible to a child. Here we explore an approach that draws on the qualities of character designs created by children to help the young user articulate their opinion more easily and rapidly without the complexities of working with the design concept. The attributes of the creations, alongside a discussion of these properties with the children have been shown through this work to help identify key issues with fewer constraints. The designed artefacts are analysed alongside a framework of Emotional Needs for the age group.

INTRODUCTION
The work of Alison Druin (Druin, 1999) and many others illustrates the significance of including children in a design process at all stages. As an adult it is almost impossible to second-guess the preferences of an 8-12 year old child. (Naranjo-Bock, 2011) However, gathering useful information during a Participatory Design process for innovation can be more difficult than for adults. Not only do adults have different needs, behaviours and motivations than young people they also communicate in a different fashion. Not only is it, therefore, a complex task to gather appropriate information and design criteria, the difference in perception and culture between children and adults can lead to difficulties in interpretation during the process. According to Mazzone et. al. (Mazzone, 2010) “Children’s ideas should be harvested appropriately when designing for them since they observe and perceive things differently compared to adults”.

Traditional participatory methods therefore need to be modified in order to compensate for typical differences in cognitive development in order to gain useful results. However, Obrist et. Al (Obrist, 2011) stated that there is still a profound lack of knowledge of how to involve children in the different phases of a product development, in particular the early conceptualization and evaluation.

BRIDGING THE CONCEPTUAL GAP.
Activities that involve defining a design outcome may not be tangible or understandable to a child (Gelderblom, 2009). It was therefore considered relevant to experiment with methods that would avoid the constraints of the design problem directly and perhaps instead represent it metaphorically. Ideally the method would allow children to include their own personality or even suggest the personality of the interface.

Storytelling and storyboarding, creating comic strips and so on have been used as co-design methods to enable both adults and children to communicate in an accessible form (Ryokai,
2012) However the methods are usually used to access information about the user as the narrator and to encourage them to tell their own story or to offer an opinion on a matter of concern.

Characters and stories both represent a familiar subject area for both adult and child. Characters are practically an everyday part of a child’s life, they have affection for them and they are frequently used by Counsellors to gain information from children sympathetically. The question was, if the brief for the creature design can be made relevant to the context could a discussion around their qualities help identify appropriate design directions and understand more about the child?

2. Efficiency as a driver for new methods. To ensure that sufficient understanding is gained, academic researchers can spend considerable time with children working on a product or interface (Druin, 1998). For example, it was concluded by Druin that children are capable design partners but this was established through regular contact over a period of months using a variety of participatory methods.

Previous work by the primary author has included a research project for a Knowledge Transfer Partnership, working with an innovations company, PDD Ltd.; the aim was to try and include user participation methods within a design process appropriate to a fast moving commercial environment. (C.Grundy, 2001) Though including the perspective of the potential buyer or user for a product was seen to be of high importance, significant time constraints dominated the duration of direct contact with the subject.

Earlier experiments with student projects at the University of Brighton and Sussex, suggested that using character design activities had potential. The children were highly engaged during the character development process and the resulting forms and their descriptions provided useful clues about the children’s feelings and preferences for the design situation. One student was designing a diabetic product that would require children to undergo potentially stressful blood testing. The use of characters allowed the child to talk about the character they had designed going through the potentially stressful test rather than thinking about the event from a more personal perspective. This suggested that use of these methods for sensitive subject areas like medical design could be a more ethical approach. (Grundy, 2012) The method appeared to facilitate ‘agency’ between the child and the designer. It avoided the need for direct questioning about the child’s life or feelings, which some find awkward. Older boys especially appear to avoid talking about feelings and voicing opinions, character design potentially provides a talking point and diverts attention from self-conscious individuals.

LITERATURE AND THEORY

PARTICIPATORY DESIGN CATEGORIES
Some time ago, Sanders ordered research methods into categories by what people ‘Say’, ‘Do’ and ‘Make’. (Sanders, 2001)

Say – What people say about themselves and their lives. This defines (usually more traditional) tools based on verbally probing people about what they think and how they feel. Typical methods are focus groups, interviews, and questionnaires.

Do – covers observational techniques. This method of understanding people is more strongly based on anthropological principles and is often referred to as ethnography. Studying what people do allows one to see behaviours that the person may not be aware of or be able to articulate.

Make – describes projective and participatory creative techniques. These tools, according to Sanders, are focused on people expressing their thoughts, feelings and dreams.

Sanders argued that it is insufficient to listen to what people say about their lives and that watching what they do and also including them creatively will reveal a fuller picture and allow triangulation of information.

These categories provide a useful starting point as they are simple to understand. However, some argue that ‘Say’ tools are frequently not useful for children due to their reliance on verbal and language skills. ‘Do’ observations have also been described as open to misinterpretation when dealing with children, because adults watching children may misunderstand their actions. Make is frequently sited as being most appropriate for children and yet without the other categories may be insufficient. The character design activity

Figure 1: Typical Character Designs that provoked discussion around a diabetic product

For more information on these and other methods see http://www.pin-lab.org/
typifies the ‘Make’ style of participation. However discussing the aesthetic qualities of children’s characters relates to the ‘Say’ style of method without the pupil having to refer to themselves as individuals. The character acts as a prop, metaphor or agent for the discussion.

A more complete literature review describing a range of existing methods has been carried out, but there is insufficient space to include the full version here.

CHARACTER DESIGN
The reasons for selecting Character Designing for the activities are discussed with references below.

CHARACTERS ARE FUN
Mazzone et al. (Mazzone, 2010) alongside Markopoulos at al. (Markopoulos 2008) have found that fun is an important issue when dealing with children. Character design is an activity that children are familiar with, through story creation and other typical classroom activity and one that they appear to enjoy and find easy and tangible.

ATTACHMENT TO CHARACTERS
Children love Characters, according to many successful toy designers and film-makers (Del Vecho 1997). Some psychologists suggest that affection for characters is a natural part of the separation process, allowing children to focus elsewhere in their relationships, beyond the parent bond and be more independent. This could explain children’s excitement over Dora the explorer and Thomas the Tank Engine, besides their apparently likeable qualities.

CHARACTERS HAVE PERSONALITIES
Characters are a useful conduit for discussion because they can have personalities, behaviours, emotions, feelings; likes and dislikes just like their human or animal equivalents. The co-design work done by others, previously described, includes the use of ‘make’ tool kits, which are usually random elements put together to allow easy creation of simulated objects without dictating the results. It appears from the work of some researchers that the actual designed outcomes are less significant than the expression of thoughts and feelings during the co-design process. If activity helps to generate a discussion between participants of different ages then perhaps a character design task could be helpful.

CHARACTERS AS MEDIATORS FOR EMOTION
Psychologists, working with traumatized children, sometimes use an inanimate object like a teddy bear or a doll to allow the child to communicate about upsetting events in a non-verbal way. The object, in one sense, acts a prop, to help where language may be limited. The third party character also helps in an emotional sense as the child is talking about events that happen to the teddy or the doll, which may make it easier to open up and talk about the problem. The character design activity for this project helps with dialogue; it may also make it less traumatic to consider the more sensitive areas for designing like blood sampling.

EMOTIONAL NEEDS
Del Vecho defined key emotional needs for children, which were subsequently used for analysing the data (Del Vecho, 1997). For example, a typical consideration for children is their need for control; most younger people do not have as much direction over their lives as adults this can be a strong motivation. In turn, this can manifest in enjoying games and activities that allow increased choice. For boys in particular the need can also manifest in wanting to appear powerful and thus they enjoy games where they overcome adversity or the forces of evil.

These requirements and how they manifest in games preferences will be explored later in the results section.

![Figure 2. Diagram for Emotional Needs](image3.png)

DATA AND METHODS
The brief for the company investigation was to find out children’s preferences for a computer game intended to provide fun and also teach them about history. The theme was similar to the ‘Horrible Histories’ style of introducing facts in an amusing and easily assimilated way. The lead academic and four Candy Labs company members visited a class of 30 school children to conduct character design experiments based on this idea. On the first occasion school pupils aged between 8 and 9 (from, St Andrews Primary in Hove) were asked to create or choose Characters that represented a period in history, describe their personality and create an associated storyboard to illustrate their behaviour and activities. On the second occasion, the
children were asked to design a game involving history as a comparison, then asked to create characters and stories. The group was divided into groups of 6 children per investigator and allowed to work in ‘friendship pairs’. Each group was given a set of cards offering a set of inspiring objects, environments and props to jog creative thinking.

Figure 3: Characters presented for both experiments.

The information gathered from the children included their drawings, video observations about the events and notes made by the adult participants.

After the event, the results were evaluated alongside descriptions of established key emotional needs expressed in a graphical format. A typical board is shown in Figure 3. The data was analyzed to see if any conclusions could be triangulated about design features and how they might meet these needs.

Each member of the design team was interviewed at a later date and their impressions of the experiment used in the evaluation of the activity against the criteria described next. The children were also asked as a cohort if they had enjoyed the activity and observation of their level of engagement undertaken throughout.

EVALUATION OF DATA
Mazzone et al. (Mazzone 2008) worked on the use of participatory design methods to create a mobile music app with children. Over a series of three sessions they worked on general considerations about running design sessions with children for design contexts. The primary evaluation criteria for their process were:

- The capability of the design methods employed in the activity to produce useful results for design.
- Is the design method suitable to engage and involve children as active participants? Suitability: verbal and cognitive, social skills, need to be considered thoroughly as these are a limiting factors on the success.
- The understanding gained about the user group during the process.

For this project, bearing in mind the rationale for the approach, it was concluded that methods should be evaluated against these criteria as follows:

1. Use for Design: the volume/quality of information relevant to the design problem.
2. Efficiency in terms of overall time spent against Usefulness.
3. Suitability: was the activity understood, were they able to carry out the activity?
4. Engagement, did the children enjoy doing the work and did they continue to remain engaged during the process.
5. Identify: The volume/quality of information gathered about the children general lifestyle and preferences for the game.

The evaluation would be considered from the interview responses from the game design team and observations of the pupils’ attitude and work.

RESULTS
Point 1: All members of the Candy Lab game development team mentioned that this was a useful experience and that it had put them in mind of the children’s way of thinking. Useful ideas had arisen from both sessions with the children. Even when the ideas were not entirely credible or usable there were also occasions where children’s thinking stimulated ideas in the listener. For example: In Figure 4. Pupils suggested that characters could be seen rising out of gravestones as a potential starting menu with dates and information on them to educate about a given character. The illustration shows the Candy Labs graphical interpretation of the idea.

Figure 4 Characters with gravestones

Figure 5 also shows a map for navigating the game and an idea for moving around using a trebuchet that were also explored.
On the whole it was also agreed that it was a useful way to interact with the children and get a general feel for their level of understanding, preferences and behaviour. The activity was therefore a relatively efficient way to gain insight in the very brief time spent in school (a total of 1 hour on the creative activity).

Point 3: The character design activity proved to be more understandable than the version where children were asked to produce a game. Four of the design team independently commented that it was easier for the children to engage with the more simplified version of the brief. For the game design some children designed the interface, some the start screen, some game fights and so on, they clearly all had a different definition of a game. They were also, in some cases, inclined to copy existing games or apps. Thus for the character design activity more time was spent on the more creative and valuable part of the brainstorming than for the game creation brief.

Point 4: All members of the team noted that the children appeared to be fully engaged in the character design activity and were quick to start the process. For the game version, they were a lot more hesitant and appeared less certain initially as to what was expected. However they did engage once they had started the process and appeared to enjoy it as much as previously. In general enthusiasm for both activities was high, according to the teacher and the observed excitement by all. An important issue here was that in some cases for the ‘game design activity’ vs the ‘character design’ a lot of time was wasted on getting excited about existing games. As time is of the essence the character design activity is considered again preferable.

Point 5: Some common themes about the children and their lifestyle, preferences and emotional needs emerged during the experiment. Many children, perhaps predictably, were interested in feeding their character, see Figure 7.

One of the stories was for a Boudicca character (Figure 8) and her chosen behaviours mirrored those of her creator when discussed more closely. This indicates the potential for the character acting as an agent for discussing the preferences of the individual.

Other common emotional themes were the need to feel protected, indicated by their characters having cloaking devices or disguises or fierce pets.

Figure 5 Map and Trebuchet

Figure 6. A menu system and health monitor typical of games.

Figure 7. Feeding characters

Figure 8. Boudicca character with her chosen behaviours and lifestyle
The emotional needs discussed by Del Vechio, for ‘power’ were indicated through a variety of ‘special powers’ that were either a part of their character or were earned by gathering particular objects. The children also introduced magic potions to elicit these powers (Figure 10).

Figure 10. Special Powers

The control issues (also mentioned in the earlier section on Emotional Needs) introduce a preference to feel powerful and to overcome adversity or conquer evil. These may account for many of the children’s ideas and examples are shown in Figure 11.

Figure 11. Power to overcome evil and other adversaries.

Children also like to demonstrate their knowledge as Del Vechio shows and this also makes them feel powerful. (Figure 12)

Figure 12. Showing off knowledge

The control instinct might also be illustrated where the player gets to choose between objects or make decisions in the game; some of these were illustrated through the children’s drawings, with choosing their weapons, pets, friends or the land they go to. An example is shown in Figure 13.

Figure 13. Getting to choose their weapon

Children also show the emotional need to socialize or compete, depending on the scenario.

Figure 14. Cooperative and social play with friends

DISCUSSION

Thus it was discovered that the character design activity was clearer and easier to comprehend than the game design concept as theorized. The feedback from the games company indicates that the character design method used can provide a useful way to gain insight into the preferences of the child for a chosen context. An unpredicted aspect of the experiment was that some of the designers also actually preferred the character design activity because they felt more confident in explaining it. The simplicity of the task seemed to put the team at ease on the first occasion.
The game designers were left with a much clearer picture of the child’s developmental stage and how better to design the game for them. Because the activity is understandable and also engaging for the children, blogs that allow later submissions and descriptions from the children could also become possible. Although pupils appear to be randomly creating characters and their behaviours, it was clear that common themes for preferences and emotional needs became visible when results are compared from 30 different children.

This will be the subject of further experimentation.

ACKNOWLEDGMENTS

With thanks to my supervisors Lyn and Richard who provided many useful references and comments. Gratitude also to Candy Labs employees, Mark Knowles Lee in particular for allowing his team members to participate. Also thanks to the three J’s: Jonny, Jim, James and not forgetting Edd for their willing involvement in the project.

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A series of co-design activities were carried out in response to a ‘real world design problem’ initiated by the Sussex Wildlife Trust. Investigations were focussed on how technological interventions could encourage outdoor play for older children (aged 8-12) who were less inclined to attend holiday clubs in the countryside than younger children. Studies have shown that spending time outdoors during formative years will encourage visits during adulthood and promote environmental awareness. The focus for the work was on developing participatory techniques for this age group that improve communication with adult partners and encourage creative thinking. In particular the use of character and story design activities facilitated open discussions about their preferences and opinions and avoided the constraints of a real design problem. Methods for this age group were adapted for the ‘Say’, ‘Do’, ‘Make’ method of triangulating data (Sanders, 2001). The children helped to co-create a series of Location Based Games that provided a useful design template for further development of the concept.

Introduction

The following paper describes research carried out to address a real world problem posed by the Sussex Wildlife Trust. The question was “How can we use technology to motivate older children to play outdoors and appreciate nature.” According to authorities on the subject, e.g. the Sustainable Development Commission, an appreciation of nature at a key age can lead to greater enthusiasm for environmental issues and encourage people to engage more fully in a sustainable society (Sustainable, 2009). There is also evidence that visiting the countryside at an impressionable age leads to a lifetime habit of enjoyment (Natural England, 2009). Young pre-teenagers can present a challenge however as, by this stage, many become less interested in outdoor play than might be desired, and typical activities organized by the trust, e.g. den building or digging for bugs have been less popular with these older age groups. Interest in digital media is relatively common, however, and can provide a key channel to access learning about the environment and biodiversity. Varied research projects have been carried out to consider how different technologies can influence location based learning about the outdoors, particularly for scholastic activities (Yvonne Rogers, 2010). However, frequently these studies are focused on functionality and how the technology could improve interaction and data storage (Druin, 1999a). There is less emphasis on why the young person might wish to cooperate in such activities in the first place, or how it might be made more enjoyable.

There has been considerable interest in the use of computer games for learning due to their powers of motivation; it is generally accepted that computer games have great capacity to engage young people. Williamson found that 87% of 8-11s played games on a console at home in the UK (2009). Games can simply be fun, but by their nature usually include a system of rewards and recognition of success or effort, which can be highly motivating. For this context, because the outcome is outdoor activity, a ‘Location Based Game’ is likely to be the most appropriate model for the investigation. There are a series of subcategories of play in this area, for example digital Geo-cashing, where the player tries to find artefacts in a particular place that have been left by fellow players; Treasure Hunts where players look for information or carry out tasks in a given place, and more social gaming versions where proximity to other players is automatically registered and interactions are a game feature. For the purposes of the project the activity will be based on specific locations due to the subject under study.
Previous research had indicated the significance of characters and stories to children, so the game was also intended to use this vehicle to add a narrative to further improve the motivational properties of the game.

**Figure 1 ARIS Game Menu**

After a literature review of appropriate forms of technology, it was considered that a phone or I-pad based APP was likely to be most accessible medium to further investigate the play requirements. From the possibilities studied, ARIS, a relatively user-friendly open source platform for creating and playing mobile games was selected. It provides a relatively simple web based, Flash system for making tours, treasure hunts or adventure games with stories that children should be able to use. Further use of an APP called Morfo was introduced as a simple way for the children to create video to project the narrative and characters from their drawings or natural phenomena.

**Figure 2. Childs drawing animated with the Morfo App**

**Rationale**

The nature of a ‘Real World Problem’ usually calls for a flexible methodology and methods that are participatory and inclusive. Due to the complex nature of the issues involved, with a range of stakeholders and questions that evolve in specificity over time, a variety of different methods will be required, including Action Research, Ethnographic studies and a Participatory approach to development of ideas. The approach here is analogous to Design Based Research, a methodology frequently applied to research that relates to the development of learning tools, however fun and motivation are more significant than imparting knowledge for the project aims. Research for a design outcome can be considered a methodology, according to Buchanan (1992), if it is properly validated during the process. An aspect of the literature review towards this project has therefore been focused on finding appropriate techniques to investigate the requirements of this group with interrogations that are age appropriate and can be ‘triangulated’ to get valid data, including Participatory and Co-Design methods.
Which Participatory Design Method?

As an adult it is almost impossible to second-guess the preferences of an 8-12 year old child. (Naranjo-Bock, 2011) According to Mazzone et. al. (2010) “Children’s ideas should be harvested appropriately when designing for them since they observe and perceive things differently compared to adults”. The work of Alison Druin (1999b) and many others also illustrates the significance of including children in a design process at all stages. However, gathering useful information for innovation can be more difficult than for adults. Not only do children have different needs, behaviours and motivations, they also communicate in a different fashion. In other words, the difference in perception and culture between children and adults can lead to errors in interpretation during the process. Traditional participatory methods therefore need to be modified in order to compensate for typical differences in cognitive development in order to gain useful results. However, Obrist et. Al (2011) stated that there is still a profound lack of knowledge of how to involve children in the different phases of a product development, in particular the early conceptualization and evaluation.

Elizabeth Sanders was one of the early pioneers of Co-Design techniques and part of her work while at Sonic Rim was to invent and apply the ‘Say, Do, Make’ model (Sanders, 2009). ‘Say’ represents techniques that explore verbal information gathering, for example through questionnaires and interviews. Traditional forms of market research rely on verbal communication between people, i.e., on what people say. The “say methods” are useful for getting an idea of what people can and want to tell you in words, but they can be limited in predictive terms. ‘Do’ represents observational techniques, like Video ethnography. These are useful but in many cases quite time consuming, often requiring extensive note taking, editing and analysis. Make describes more projective methods that involve creative techniques with the user, including co-designing. Sanders’ work provides a semantic and practical categorization of the variety of methods available. An ideal situation would be a triangulation of information from all three Say, Do, Make categories. This project includes an attempt to investigate how we can apply the Say, Do Make tools for triangulating data.

Children as Design Partners

One of the more obvious reasons why ‘Say’ tools can be impractical for younger children is their relative inability to verbalize their responses. Methods that rely on description and memory are less likely to yield fruitful results, in either written or spoken form, than some alternatives. ‘Do’ tools are based largely on the observations of the design researcher and therefore a certain amount of interpretation is required. A child’s world seen through adult eyes is open to misinterpretation and needs to be triangulated and tested against other results. Of the three approaches the ‘Make’ tools seem to fit with a child’s ability and engagement most successfully. Despite skepticism in some quarters, Garzotto (2011) suggests that beyond the traditional roles of children as users, testers and informants, children are highly capable of being Design Partners and taking a more creative role. Alison Druin is also a proponent of including children as active designers through a process called ‘Cooperative Inquiry’ This also includes children as observers and researchers of others besides being arbiters in the design decisions (1999b). Creative activities rely less on language and memory, which in childhood are less developed skills: Secondly, creative activities appeal to a child’s imagination and this is one of their main assets. In the words of Vaajakallio et al. (2009) ‘Children were motivated or even enthusiastic with the Make tools.’

Bridging the Conceptual Gap

Cognitive Psychologists have shown that children find it difficult to conceptualize ideas that are abstract in nature (Gelderblom, 2009). Design problems at the beginning of a development process require ‘blue skies’ thinking about new artefacts whose form cannot be pre-defined and therefore may appear intangible to a child. Activities that involve defining a final design outcome may not be tangible or understandable to a child. Methods that avoid the constraints of the design problem directly simplify the task. Storytelling and storyboarding have been used as co-design methods to enable both adults and children to communicate in an accessible form (Ryokai, 2012) However the stories are usually about the user as the narrator and encourage them to tell their own story. Earlier experimentation has shown that a process involving the creation of stories and characters can provoke conversation and also presents useful insights into the world of the child (Grundy, 2012). Frequently their preferences and, in some cases, personality are expressed through the designed character and their adventures. Characters and stories both represent a familiar subject area for both adult and child. Characters are practically an
everyday part of a child’s life and they certainly have affection for them. They are also frequently used by counsellors to gain information from children in a sympathetic fashion. Thus the initial stage of the project involved creating characters and stories around the subject. These would later be relevant to the pupils designing the outdoor game, having been informed by the activity, however they also allow clear communication between the different members of the design team and provide information for later design efforts.

Methodology

A literature review had already been carried out to identify suitable technologies, games software and participatory design methods. Interviews with a series of wildlife experts and further study of environmental issues had also informed the experiments. The investigations with children were organized into two phases across two different schools. Phase 1: The project started with two school classroom visits, to St. Andrews school in Hove, in each case with a group of thirty pupils aged between 9 and 10. One group were asked to create characters and stories around their favourite natural subjects, the other were asked to create game scenes using their favourite natural subjects. (both relate to Sanders ‘Make’ methods) This was done to compare results in terms of use of information for the game and how understandable the activity was. They were also asked to complete an online survey that related to their habits for outdoor play (‘Say’ methods). Phase 2: A group of twelve pupils from Fairlight primary school, aged between 10 and 11 were asked to design a Location Based Game for a local park over a five week period. The pupils worked in groups of three during the project. Week 1 they were taken to Stanmer Park and at specific locations, asked to take images of what they considered interesting phenomena. This was done from inside the ARIS game environment, so that the points were geo-tagged and ready to be used in the developing game. While one pupil had an I-pad, another took video footage of the experience and the third made notes. During week 2, the pupils were introduced to the concept of location-based games and worked with the ARIS interface. For week 3, Character Designs and Stories were developed for the game scenes. During this process the conversations were observed and recorded. In week 4, the games were further developed and videos created of natural objects in Morfo. Eventually in week 5 the pupils played the games outdoors in the park and again one member took video of the experience. Four successful games were eventually produced.

Results

For Phase 1, evidence for games characters and suitable game scenes was successfully gathered for both groups. The activity also provided a good discussion opportunity with group facilitators to find out more about the children and their preferences for the context.

Sometimes, pupils who were asked to create games resorted to copying other known games (one example is illustrated in fig 3) and in some cases were confused about what the required outcome should be. This yielded further evidence that the character design and story activity is preferable to a request to provide potential game designs. Nature and creature preferences were also identified, e.g. squirrels, rabbits etc. were preferred, slugs and bugs were considered ‘the baddies’. More broadly the activities helped to identify key properties and themes of the game, for example social aspects like parties with friends were a common theme, typical power games like defeating evil and so on. The survey helped to put the pupil’s interests in a broader context.
During Phase 2: The pupils all managed to successfully create a playable game, however evidence indicated that they were more interested in playing their own games than each other’s. It was noted by all of the adult participants that it was difficult in the timescales for the children to produce a game that coherently communicated its goal and the tasks in hand. This suggested that either more time was necessary, or that the results should be interpreted in a more participatory fashion, to provide information for further development by the designer at a later stage for testing with the children. The character design and story co-design activities for this phase also provided a useful basis for deciding the content of the game characters and their activities. The videos and observations by group members helped to identify game characteristics, e.g: The distance between points should not be more than 30 metres or children lose focus and get distracted by other features, directional clues and illustrations of the next point should be provided as map reading is difficult for this age and sometimes frustrating. All design conclusions are too many to detail here.

Conclusions

The character and story design method, provided an excellent opportunity to discuss ideal preferences with children without the technical constraints of the design problem. The game creation co-design activity itself generated useful data but would need further development from a design expert to create communicable games to others. The methods chosen, when added to the ethnographic observations and survey results were effectively triangulated using the Say Do Make method.

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‘GAMES IN THE PARK’: STORIES AND GPS BASED FUN TO ENCOURAGE INTERACTION WITH NATURE

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ABSTRACT
The ‘games in the park’ project investigates how technological interventions can encourage outdoor play for children aged 8 to 12. A series of location-based games have been created via a co-design process in response to a real world design problem highlighted by a local wildlife trust. The trust had found that 8 to 12 year olds are less inclined to voluntarily attend countryside events to learn about nature than younger children. The focus for the work was to develop games that make use of Global Positioning System (GPS) data to encourage interaction with nature by older children. A key challenge in this design problem is achieving a balance between the user engaging with the physical environment whilst maintaining awareness of the game directives through mobile technology. In particular, to investigate how the flow of activity through the game could be maintained, comparing the use of rewards for tasks in contrast to the use of characters and stronger narrative elements. The children helped to co-design and create a series of games to inform the project. Both the reward focused and character/narrative game types were enjoyed equally in this experiment. A series of other observations helped to refine the complex ‘wicked problem’ being investigated and extended the development of design guidelines for games of this type.

KEYWORDS: Location Based Game, Co-Design, Design for Children, Outdoor Play

visits during adulthood and also promote environmental awareness (Rawles, 2009) (England, 2009b). Sussex Wildlife Trust, a nature conservation organization in the South East of England, run a series of wildlife clubs during school holidays to allow children to experience and learn about natural environments. They have identified a need to encourage older children to participate in the events, which are more frequently and willingly attended by their younger counterparts. This is an example of a complex, issue, often classified as a ‘real world problem’ (Wisker, 2007). This provides the context for a wider research project, addressing the question of how mobile technology can be best used to increase enthusiasm in older children for outdoor activities, which is the subject of doctoral research at the University of Brighton. This paper discusses a particular design experiment for this project. These experiments have also received support through the University of Sussex as part of a widening participation scheme. The broader research question posed is:

- How can a location based game be optimized to maintain engagement and interaction with the physical landscape for older children during outdoor play?

Given the aims of this project, investigating motivation and enjoyment takes priority above measuring learning outcomes. The context is not a formal classroom activity, and the emphasis is on fun, engagement during interaction with both the landscape and technology and continued motivation towards the activity over time. This points towards research and design methods that include affective and emotional responses, related to Experience Based Design (Shedroff, 2001). Putting together the motivational effect of games and a mobile/contextual learning scenario leads to the conclusion that Location Based Games based on GPS technology could provide an avenue for investigation.

As a preview to the experiments described here, an ethnographic observation of the wildlife holiday clubs, with SWT as a volunteer, provided a ‘fly on the wall’ perspective on the activities presented and the children’s reaction; this was in the same location as the proposed game development, Stanmer Park, in Brighton. The park has indigenous natural species. In total there was participation in 6 holiday club days with the SWT for ages 6-13. This helped to identify the activities that could possibly be adapted for location

1. INTRODUCTION
There is evidence that spending time in the countryside during the formative pre-teen years will encourage consideration...
based games and which were less interesting for the older age group. Paper based co-design processes used at the beginning of this project were also developed as a result of earlier work with this age group; these elements are discussed in a previous paper (Grundy, 2014a). This phase of the project is an exploration into how different game structures and methods of sequencing information might influence engagement with the activity. The particular question under investigation through the workshops described in this paper can be further defined as follows:

• What are the criteria for designing the interaction points, structure and interface to enable effective and enjoyable play with nature through a location based game?

To create the games we used ARIS, a game creation platform developed by researchers at Wisconsin University, which allows the addition of characters, and other media in situ playable via a phone App (ARIS, 2014). The focus was get user feedback on games created according to different models, which was achieved through asking participants to play example games created by the researchers, before creating their own games in line with the different approaches. One researcher-created game adopted a ‘treasure hunt’ model, with a random sequence of points to be visited and a set of in-game ‘rewards’, such as a golden leaf. A variation of this game was also created which had a numbered sequence rather than points to be visited at random. The ‘treasure hunt’ game was later contrasted with a version including characters and a storyline to script the activities. Children often find fictional characters to be engaging, according to many successful toy designers and film-makers (Del Vecchio, 1997). For this reason we wanted to investigate whether the addition of characters to location aware games would increase enjoyment and levels of motivation for this age group.

2. BACKGROUND

Organizations such as Natural England (England, 2009b) and the Sustainable Development Commission, report that appreciation of nature at a key age can lead to greater enthusiasm for environmental issues and encourage people to engage more fully in a sustainable society (Sustainable, 2009). Children who are too young may not understand key themes or remember the experience well and teenagers, by contrast, have often already established habits and behaviours, so this intermediate age group offers a critical window of opportunity. There is evidence that visiting the countryside while younger can lead to a lifetime habit of enjoyment (England, 2009a). This age group can present a challenge, however, as by this stage many become less interested in outdoor play than might be desired, and typical activities organized by the trust, e.g. den building or digging for bugs have been perceived as appropriate for younger children. Interest in games and digital media, by contrast, is relatively common and could provide a key channel to access learning about the environment and biodiversity with careful introduction and appropriately designed interactions. Outdoor learning has seen increased interest during the last few decades (Fagerstam, 2012). Experiential Learning, where the participant interacts with an environment or situation related to the learning outcomes, has long been considered a valid approach with early proponents including Piaget (Piaget, 1983) and Dewey (Alexander, 1998). Further theories following this movement include Situated Learning Theory (Jean Lave, 1991) based on principles introduced by Vygotsky (Seeley Brown, 2003). In this case the definition is that the ‘Construction of meaning is tied to specific contexts and purposes’ (Wilson, 1999).

Lately with advances in mobile technology, there has been increased opportunity to take learning out into the field and allow direct experience of phenomena with appropriate educational prompts. Frohberg, et. al. (Frohberg, 2009) studied 102 mobile learning projects and discovered that one third of mobile learning projects strive to move learning away from the class to natural environments. Technologies developed to support the exploration of natural settings include, for example, learning about woodland ecology (Bahtijar Vogel, 2010) and helping with data collection or recording the environment, for example bird watching e.g. Chen, Kao, Yu & Sheu, 2004 (Chen, 2004). Successful introduction of mobile technology to supplement formal classroom education has also been facilitated by children’s fascination with the technology itself and consequent motivation towards the learning activities presented through it (Rogers, 2010). Much of the later work on situated mobile learning stresses the need for studies that consider how users will switch from the technology being in the foreground to the physical environment being at the fore (Elliasson, 2013). Informal uses of mobile learning in a natural context have also started to emerge. There are a series of subcategories of activity in this area, for example digital Geo-cashing, where the player tries to find artefacts in a particular place that have been left by fellow players; Treasure Hunts where players look for information or carry out tasks in a given place, and more social gaming versions where proximity to other players is automatically registered and interactions are also a game feature. Though promoting the use of technology in a natural place is possibly a controversial step, if adequate emphasis is given to guiding the player/user through a series of experiences and interactions with the countryside, and such experiences subsequently appear more inviting, the outcome could be considered positive. However, a significant problem is that technology can be a distraction from engaging with the real physical world. Rogers, Connelly, Hazlewood and Tedesco (Rogers, 2010) studied the use of technology for entering data or looking up information to support scientific investigations on an ecological restoration site. They argued pupils might have difficulty switching between the mobile technology and the physical environment. Earlier investigations led to some useful conclusions about the parameters for a location-based game in this context and these formed a series of Design Guidelines (Grundy, 2014b)
The nature of ‘real world’ research can be considered to present a ‘wicked’ problem, i.e. one with complex questions with regard to the activity and systemic impact on the individual, their social sphere and the environment. A worthwhile design research contribution can, therefore, involve a series of variables, whose relationship to the design may be difficult to fully determine at the beginning. Design research therefore usually calls for a flexible methodology and methods that are participatory and inclusive to gain evidence to support decisions. The approach is analogous to Design Based Research, a methodology frequently applied to learning tools, in that it follows an iterative process where the research problem and solution are continually refined until the wicked problem can be ‘tamed’. Examples of this iterative approach through a practical design application include Concept Driven Design by Stolterman and Wiberg (Wiberg, 2010) and the Design experiment Cycle by Mor (Mor, 2010); this was later interpreted by Eliasson (Eliasson, 2013). More flexible models have been proposed for situations that are less empirically based and have more emphasis on a particular context with associated social or cultural requirements, under the general philosophy of ‘Research through Design.

3. APPROACH

The requirement to understand the experience for a target audience plays a more significant role here than effective learning. The ‘Research Through Design’ approach followed for this project therefore emphasizes a participatory design approach with the children, with the intent to address their preferences and emotional needs, rather than learning projects where the view of the teacher may be foremost in the hierarchy of stakeholders (Eliasson, 2013). A significant part of the literature review for this project has therefore focused on finding appropriate techniques to investigate requirements of this group with interrogations that are age appropriate and can be ‘triangulated’ to get valid data, including Co-Design methods. A method for doing this is proposed by Sanders; she suggests listening to what people Say, look at what they Do and watch what they Make, the Say, Do, Make model (Sanders, 2001) One of the more obvious reasons why some tools are impractical for younger children is their relative inability to verbalize responses. ‘Say’ methods that rely on description and memory are less likely to yield fruitful results. Observation tools are based on the perspective of the design researcher and therefore a certain amount of interpretation is required. This may be fine when addressing an adult audience, where a similar level of cognition occurs. However, a child’s world seen through adult eyes is open to misinterpretation. As an adult it is almost impossible to second-guess the preferences of an 8-12 year old child (Naranjo-Bock, 2011). The work of Alison Druin (Druin, 1999) and others illustrates the significance of including children in a design process at all stages, i.e. ‘Make’ methods. However, gathering useful information for innovation can be more difficult than for adults. Not only do children have different behaviours and motivations, they also communicate in a different fashion. In other words, the difference in perception and culture between children and adults can lead to errors in interpretation. This led to the development of a process where the children created their own sketched characters and stories to illustrate a scenario. During this method they discuss with the researcher their creations and the reasoning behind it.

This was shown to reveal their preferences and in some cases their emotional needs. This is the subject of a previous paper, by Grundy, C., Pemberton, L., and Morris, R. (Grundy, 2012) and the method was also employed during this work.

4. METHOD

Workshop 1: A study was undertaken in June 2013, with a series of one and a half hour workshops held over a 5-week period with a small primary school in Brighton. The character design activity was conducted with these pupils as a preface to the next stage of implementing their ideas in a game using ARIS. The pupils worked in groups of three. The initial phase required them to take photographs of natural objects they liked and Geo Tag them to identify locations for their game. One member of their team would hold the iPad while playing the game and another was given a video camera and the other was asked to observe and help the others. They were told to swap roles at regular intervals. They then used their content and
character/game designs in ARIS with these points to create their location based game. The pupils made animated videos of their drawings using an app called MORFO to add content to the game. The pupils subsequently played their own game and a team member videoed their progress. At the end of the final session pupils were asked to fill out a short questionnaire which asked them to rate their experiences on simple Likert scales.

**Figure 4: A Character animated in MORFO**

**Workshop 2:** For the 2014 experimental phase, a two-day workshop was conducted with 12 different pupils from Fairlight primary school (in June again). The pupils again worked in groups of three. For the first day, they were asked to play an example Treasure Hunt game to start with that led them to a series of 5 points and presented different possible activities. This was to illustrate some of the capability of the ARIS game. Some points simply gave information, for example one suggested they observe the swallows and their swooping action to catch bugs; another involved collecting objects with different attributes and photographing them. The activities corresponded to typical SWT activities. They were rewarded with a golden object after successfully completing each mission. One version of the game had numbered points on the interface, with directions embedded in the game from one point to the other, the other did not label the points but still had the embedded instructions. They then used ARIS to create their own Treasure Hunt style game.

The second day, they started by playing their own game to see any issues that had arisen with it. Then they played a version of the game with Characters and Stories in. This included videos created in an App called MORFO which can animate a photograph, including children’s drawings. These were already created and helped to direct pupils to the next point. There was a conclusion to the story with a point appearing after they had visited all the other points and done the experiments. The points were similar to the first group. They then, similarly created their own MORFO videos to tell their particular story and made their own version of the Character and Story game.

**Figure 5: Character Design game version**

**5. RESULTS**

**Workshop 1:** The first workshops in 2013 helped to provide general guidelines for the game parameters for this age group. The pupils all managed to successfully create a location based game and all but one pupil enjoyed both making and playing the game, according to the questionnaire responses. This may have been due to an issue with group dynamics. Though others have noted the children spending too much time on the technology, this phase also flagged up contrasting issues of the children forgetting the game and getting carried away with climbing trees or other environmental features. While this may be desirable in terms of physical engagement with the location, it is also ideal to maintain a flow of activity in order to encourage the visitation other features or for the player to be motivated to return on other occasions. A balance of focus needs to be created and a flow of meaning through the whole activity considered. A significant observation was that many pupils found it difficult to read the map to locate themselves and a lag on the GPS system meant that some walking was necessary before it could be established if they were travelling in the right direction. This could effect engagement in the game and led to the conclusion that more emphasis on the consideration of way-finding, and locating the next point with relative ease, might help with continuity and a desire to carry on to the next activity. It was decided to further experiment with contrasting different clues to the next location, for example: numbering, written descriptions and a storyline to create a sequence. The distance between points and having an accessible location also influenced enjoyment. For further research, it was concluded that if enjoyment is to be evaluated, the following game parameters should be fixed: Distance (total and between objects) should be less than 30m; the number of objects between 5-10; the same locations should be compared across experiments and the same level of difficulty; compare results in the same weather conditions (and season); keep consistency of graphical style and the interface as far as possible. Another observation was that ARIS is a trying interface for some young people to develop games at times, with a few non-intuitive aspects to its use. It may have influenced the progress made towards game completion, though they all created something, they were not necessarily as finished as the children might have liked. It is, however, the most appropriate medium for adding characters and stories discovered so
far. A more concentrated period of use might therefore be preferable to get to grips with using it. As this is a mechanism for co-designing rather than part of the game to be evaluated it was decided to persevere with it. Some pupils were still wondering when they were going to play ‘a computer game’ at the end. It may be that they didn’t make sufficient progress to have a fully implemented game level, or that they did not accept that their own drawings and MORFO videos were acceptable as a finished ‘game’.

**Workshop 2:** Interestingly, the pupils did learn the basic facts ‘hidden’ in the pre-constructed game and some reused the information in their own version e.g. recognizing elderflowers or added their own, e.g. one group added observed insects inside flowers, another included ivy and asked viewers to note the effect it had on the tree. The pupils also engaged in activities through this game, e.g. den building and gathering natural objects that were very similar to the original SWT holiday clubs. Thus the software was successful in directing these activities and imparting basic facts in the absence of a human director. The game version with the numbered points appeared to help to add clarity to the game sequence. When playing the second ‘characters’ version, it was noted that the pupils were already a little tired after finding their own game locations. They also were put out if they had to return to any point on their previous game, or to backtrack in the same game. It seems that much of the enjoyment is in moving forward into new terrain. It was difficult to evaluate the pupils’ ability to find the next point between the two game styles as the map had become more familiar to the pupils by the second day. A questionnaire revealed that, despite being asked which game they preferred, most did not wish to express a preference, with only two preferring the characters version and one the golden object treasure hunt version. The girls, on observation, seemed more interested in the natural characters than the boys. For one group of boys, their own story included survival army type games, which also concur with some of the typical activities that SWT provide. All of the groups were successful in creating the Treasure Hunt game using ARIS, though they didn’t have time to add rewards on the whole, and they also managed to design a version using the Characters, which they designed and created MORFO videos for. Unfortunately due to an issue with the Internet, they were unable to load their MORFO videos to the game, which may have influenced their final appreciation of this activity.

**6. CONCLUSIONS**

The results are based on an explorative approach and the workshops contain small groups of pupils, therefore the results are tentative but provide useful points for further test and experimentation. There was no significant difference in enjoyment of either game, even though a questionnaire explicitly requested a preference, pupils could not decide. In other parallel experiments, the characters and stories had been evaluated as having more appeal than a basic treasure hunt. However the addition of golden rewards might have addressed this bias and added more appeal to the treasure hunt. It may also be true that the activities and points were too similar so that the pupils felt they were just repeating actions the second time they played the game. This may have also been influenced by their relative success in making each game (and the difficulty with adding MORFO videos). In future questions about making or playing the game should be separated in future. For further experimentation, it may be necessary to contrast two different groups coming to the activity for the first time, in sufficient numbers to get a rigorous analysis. This should also be the approach to evaluating the way finding aspect of the game as familiarity with a location over a series of experiments interferes with the results. This could also be contrasted with the same group and similar activities at different location points. The game goals need more consideration and a ‘future workshop’ as a co-design activity would provide useful design guidelines for future implementation and test. The pupils enjoyed making the games for both workshop series, the use of MORFO is always particularly well received. However, they don’t necessarily seem to appreciate the results of each other’s animated drawings. In the next advancement it is planned to prepare some more professional content with different types of appeal to evaluate their appreciation with the children.

**REFERENCES**


8.3 Documents Relating to Chapter 3:

8.3.1 Methods in more detail.
8.3.2 Ethics: Parent Information for MindCandy Experiments.
8.3.3 Consent Form: MindCandy Experiments.
8.3.4 Interview Transcript.
8.3.5 Concept Map of Game ideas for brainstorming after co-design MindCandy.
8.3.6 Alternative Game Engine Options.
8.3.7 School of CEM Ethics Form.
8.3.8 DBS Document
8.3 Relating to Chapter 3

8.3.1 Further detail on methods chosen

Say Methods:
Semi-structured interviews.

One to one discussions using a conceptual map of topics that the interviewer refers to, rather than a more closely defined, structured, set of questions used for some research projects. This allows the expert to guide the discourse, with prompts from the interviewer so that the conversation can wander in directions the expert thinks is important. The interviewer can refer to the template to ensure the relevant subjects have been covered but should ask open questions and encourage flexible responses. This is useful where the interviewer may not be aware of all the points that need to be covered.

Children were not interviewed individually, this is often not advised as discussed in Chapter 3 on methods appropriate to children.

The interview template used for natural experts is shown below
Appendix

Survey:
An on-line survey is a convenient way to obtain answers from a larger range of respondents, who may be in different locations, for a precise set of questions and it also provides an automated system for collating and analyzing the data. SurveyMonkey, a typical tool was used in this case.

Questionnaires
Where there was no access to the internet, or immediate feedback was required after a fieldwork activity in situ, paper based questionnaires were used. The questions were usually aimed at finding out if the children had understood an activity and to rate their enjoyment of it, using a modified, simplified version of Likert scales, shown in fig. There were also specific questions about game content or features, where the child added a written response.

Do Methods
Observation
Observational techniques investigate behaviours and practice in a relevant environment, in this case in a natural setting or classroom. Observation is a key technique employed within design research. Marshall and Rossman (2006) discuss the importance of observational studies as a method for use in investigating complex interactions in social settings. The process involves watching, listening, participating and thinking. This is distinct from a “design ethnography”, where the inquirer spends time in the home or work environment of the user. Though the process is similar, the environment is one selected for
them, rather than one they naturally abide within. A recording process was used to back up the observations made, where possible for later revisit. This was useful where there were multiple subjects to observe.

**A/B testing:**

A/B testing was used to compare particular game attributes. This is the process of comparing two similar prototypes that have differences in certain properties under test. Although it is frequently considered a quantitative activity, A/B testing can effectively be used to investigate qualitative problems, e.g. which solution do the children like best? This was used, for example to evaluate which of the techniques for making media appear at a particular POI were preferred. Where the children were being observed, having two alternative games for them to play and be observed also provided more scope for other qualitative information to be obtained.

**Make Methods:**

Co-design is often used as an umbrella term for participatory, co-creation and design processes open to stakeholders. A key tenet of co-design is that users, as 'experts' of their own experience, become central to the design process. This approach goes beyond consultation by building in equal collaboration between those attempting to resolve a design challenge. Facilitators, usually designers, provide ways for people to engage with each other, communicate, be creative, share insights and test out new ideas. Background to how the following methods were chosen or developed is described in Chapter 3.

http://designforeurope.eu/what-co-design

**Co-Design: Paper based methods.**

A series of creative activities were developed, which allow the observer to understand more about the child and their preferences during the creative process. The activities related to the children designing an aspect of the game, but were frequently also a talking point to allow a conversation that did not intimidate the child and avoided asking direct questions about them. This included the development of characters and stories as game content and sequences of game activities.
Co-Design: Computer Based Game Development:

1. To co-create location based games, ‘ARIS’ was used as a game engine to make the process accessible, described in more detail in Chapter 3. The programme facilitates creation of various media productions but for this project, was used to place items, media and characters at different GPS locations. The game is created on a browser by the children and later accessed for play through the ARIS mobile App, on location. The media can be viewed, characters can be interactive and the items picked up as the appropriate GPS points are visited live during the field trips; performing these actions can reward the player by unlocking further game play and the player can ‘win’ the game by visiting all the locations and performing all the required actions. Media can be added to any of the objects, including video, sound, images and text.

2. MORFO, an animation APP was used to obtain the view of children and also create game content. Through a simple, adapted process it allows them to choose a subject and create animated characters to express ideas and opinions. The animations can later be added as characters or plaques within the games the children produce.

The children can design a game of their own using these applications for others to play.
Appendix

8.3.2 Participant Information Sheet:

Mind Candy History Game Design and University of Brighton Project

Introduction:
Mind Candy are a local games company that were responsible for the creation of Moshi Monsters. This is a popular game and toy brand that many of you will have heard of. An exciting opportunity has arisen for our children to participate in the development of a new game based on history and ancient battles for the company. This will simply involve an hour of the children’s time and will include the creation of stories and storyboards and perhaps a final puppet show. They will also be shown the prototype of the game as it exists so far. In return the school will be receiving £100 towards books and all children participating will receive some Moshi Monster goodies. The methods we are using to discuss ideas with the children are based on new research methods being assessed through the University of Brighton. As such the children are also helping to contribute towards new ways that help to understand their preferences and behaviours for the design of learning games and toys. Both Cathy Grundy and the Mind Candy production team are fully DBS checked. You will need to fill in the enclosed consent form if you agree to allow your child to participate and be videoed in the process.

What is the purpose of the study?
The main purpose is to find out what children already understand about the history of the Vikings, Romans, Normans and other ancient peoples and what could interest them or engage them in the subject. During this process we also wish to evaluate a way of generating stories using characters and props that help them to talk about their interests. Eventually some of the stories and ideas may feature in the final game. Children will be involved later to see the results of the game development process to see how their work has helped the team and also to educate them about how games are created.

Why have they been chosen?
The theory is that children know best what children like and what they understand. If we want them to enjoy playing and also learn useful facts about a subject, it helps if we can understand what motivates them. In creating design ideas the children will be producing material that other children of a similar age will enjoy and benefit from.

Does my child have to take part?
‘No. It is up to you and your child to decide. Your child is free to withdraw at any time. A decision not to take part, will not affect them. The children will be occupied for an hour. This should be very enjoyable for them, but they do not have to do it.

What will happen to the results of the research study?
• Photographs or video footage will only be used for research purposes and will be stored securely.
• Further permission for the use of any images for publicity or marketing will be requested subsequently.
• Information in the form of images, sketches or write-ups of the discussions will be anonymous and may be used in a final dissertation and will be viewed by PhD supervisors at the University of Brighton; Lyn Pemberton, and Richard Morris only.
• Any research data will be destroyed after 7 years and stored in the interim securely.

We hope that you will be happy for your child to contribute, but non-participation is also not a problem. Please feel free to contact Cathy Grundy (07961413066) If anything is unclear and you wish for more information.
8.3.3 Consent Form

Title of Project: Game Design project

Name of Researcher: Cathy Grundy (University of Brighton) and Kate Howland (University of Sussex)

Please read the enclosed information sheet and if you agree to your child participating in this exciting project:

• add your name and your child’s name at point 1.
• Sign the photography consent at point 5 if you agree to it
• Finally sign the form at the bottom Thank you.

1. I ______________________________________________________ agree that my
   child __________________________________________________ can be involved in
   this project.

2. I have been informed of the nature and purposes of the study and have read the
   information sheet.

3. I am aware that my child will be asked to create drawings and stories and participate in
   discussions about nature. I give my permission for Cathy Grundy to use excerpts from the
   designs and discussions involved.

4. I understand that participation is voluntary and that my child is free to withdraw at any time
   without repercussion.

5. I give permission for photography to be taken of my child and understand that they will be
   used by the researchers involved for research purposes only.
   * Yes / No
   * Please delete as appropriate

6. I also give permission for photography to be used in University publications or on the
   University Website.
   Yes/No
   * Please delete as appropriate

7. I understand that personal details, images, video and photography will remain confidential.
   Data will be stored in a secure area and destroyed after 7 years.

8. I understand that the data collected will be used as part of a dissertation project. I
   understand that the data will be used in writing up and disseminating research (including in a
   dissertation which will be held in the School of the Environment & Technology University of
   Brighton). I understand that only anonymous excerpts from the research will be used in this
   write up.

________________________________________________________________________
Name of Participant  Date  Signature

________________________________________________________________________
Name of Parent  Date  Signature

________________________________________________________________________
Researcher  Date  Signature
8.3.4 Interviews with MindCandy Staff, on History Game

(See also interview template)

Interview with Jim

Jim has worked with Origami Blue/ CandyLabs/MindCandy for 18 months
As a game artist. There for both weeks.

J: The second week was harder for the kids to grasp. They understand narratives
and stories and are exposed dailily to it obviously developing a game is harder and
more involved for anyone not just kids.

C: What about for you to understand too and communicate?
J: Easier to fire and forget with the story and they could run with it themselves. Less
input from use firs week. They needed more guiding on the second week.

C: Information How valuable was it
Did anything come out of it?
J: I think so yes, they came out with interesting ideas. Things like souls trapped in
swords and souls combining when they were killed. It might not go in directly, but
was interesting for the general themes.

The surreal mixture of things they come up with and just add more weirdness and
mash up more different stuff.

C: Which of the two weeks more valuable in terms of how they think
J: The story week was valuable because when we ask about the game they refer to
existing game mechanics, which is totally understandable. More original in the first
week, rather than talking about Call of Duty or Moshi Monsters.

C: Perhaps we should have had a brainstorming after week 1?
J: Should have collated it properly. The game play testing was valuable. I don’t think
we did much with the material and there were ideas that could have helped us.

C: Video?
J: Time to edit it. Not been a priority. Don’t know and haven’t had a session where
we brainstorm around the sessions. Would be good.

C; Did you learn more about their level of understanding?
J: Yes. They were influenced by the images we put in front of them, they understood
the game

C: Did you think that it was a useful thing to do?
J: Yes very much so. Other people in the company think we should do more of it.
Yes Shoreditch, don’t know why we don’t do that kind of thing more often.

C: Anything wrong with it?
J: No I don’t think so. Not really. Maybe could have planned it more, possibly good
to keep it flexible.
Appendix

C: Should I have come in and done a talk about co-design would it have helped?
J: Would have been interesting, but don’t know if makes it more useful.

Collating the brainstorming needed to happen more thoroughly. At the moment we can’t really pin point exact stories or characters that will go in but its just the stage we are at. Core demographic is 10 year old boys.

Girls said there should be more female warriors. Not sure if that will be included I am concerned that we may not have that option.

Interview with James

James has been with the company since it started, as an animator

Ja: (same questions) Second week was harder to see what was them getting inspiration from existing games. Customization, selecting characters, ticking game boxes. First week was a lot more interesting as it was just ideas and a lot less constrained and it was cert

First week was also easier for me to understand. Second week was too constrained. Need to look at video

Prototype interested in it. Play sessions revealing to animator Probably got different things out of the session

As an animator like to see the feedback. Unexpected results: “Majority of the time built for one child, interested to see how they adapted it for group play”. Cooperative play.

Could they understand the animations, did they like the character feedback, studying the children’s reactions. That was successful, they enjoyed the character jump up high when they had won. For you the testing was the key thing.

Ideas more ‘off the wall than expected at times’
Time machine: “how are all the different characters from different times going ot interact. “
When asked about the story, and if it helped with the ideas: Not my field really, but I think there were.

C: Do you think that working with the characters and stories is easier for you as the game developer?
C: Do you think that characters and stories are easier for the children?

Anything would improve: “I think we need definitely do some AB testing” One to one testing as not clear if they couldn’t do it or had learned from each other.
Interview with Jonny:
There for both weeks.

C: Did you feel the children understood?
Jo: The first one the kids understood a lot more what we wanted from them. They
could get their heads around what makes a story. Its hard to ask them, what would
you put in a game?

I found it harder to talk to them about the game but in some ways that was useful. It
was interesting to hear what they think a game was. What do we ,do how is it made?
Their opinions about what makes a game.

C: Did you find that their imagination was stifled because they had a stereo type of a
game in their mind.
Jo: Yes, they did get suggest certain things from existing apps and ipad games.

Did you feel that the story helped to focus on their ideas and preferences? Did the
focus on the game confuse matters.
They do seem to project a lot of ideas that relate to them, like discussing family.
Yes their universe is smaller I suppose and they have less experience.

C: Did talking to them spur your own ideas? Yes I think so I cant really recall a
specific instance. I loved the starting off naked, humour is great.
I am always doing that it’s my job so I probably won’t remember. I do remember the
clever boy who did his drawing about the trebuchet firing his character over the wall.
That made me think of how it could be adapted from the game. He sat back and
read a book afterwards, I remember that. I got a lot from it,. One thing we have not
done is watch the videos but I think we will get a lot from that and it will spur our
thinking.

With the story they understand exactly what it is. It was more about the story around
the characters as people and their relationships with each other, warriors marrying
each other and travelling, their understanding of the history came out in that week.
Most of them copied a picture of a warrior first of all.
The second group were ‘what do I do? “

It helped me to get their general sense of humour. We were thinking too grown up. I
was amazed by how much they knew about history. Some of them did appear
interested in learning about history too, which was a surprise.

Do you think it depends on your role what you got out of it for each session and
which session works better?
Yes definitely the more technical chaps might be more into the prototyping.

Do Better?
We definitely should have had a beer and a get together after each one.
Appendix

In terms of knowing what might go into the game, the first week

Yes to AB testing. And make it more structured.

Should have described the process of making games on the second occasion.

Interview with Ed

Ed was only there for the second week (where the kids designed a game).

Been working with the team Origami blue/ Mindcandy total 18months. On the technical programming side. Rob has joined in similar role.

How easy was to understand what the children had to do?
They got a bit hung up on the fine details of the game. Felt that had to guide them a lot. A girl found it really hard to get going. The boys were going into the task too widely and wanted everything in it. Some didn’t know where to start.

“ Felt that I might be leading the children and including too many of my own ideas”

Did anything useful come out of it?
“ I was more focussed on trying to talk to the kids, I have just had a baby and I am not used to talking to kids, so was quite daunted by the activity and worried about my interaction with them and probably didn’t concentrate on what they were saying. “

One kid had played Moshi Monsters, had an ipad and he got really focussed on details and hung up on payment methods and so on the things that tick the game boxes rather than the creative side.

General information: It was useful to get an idea of their general intelligence level although it did vary. I was surprised about the enthusiasm of the girls. I understood more about their perspective on time

The play testing was probably most helpful on the technical side. Our original idea was to make 3 prototypes.

How efficient was it as a use of your time?
For me being technical it was the user testing that was most useful.

May be very useful to a games designer, we generally do that as a group, but I generally get hung up on how it works in practice.

If I did it again I wouldn’t be so ‘aaahh kids’ (intimidated by the activity) and would spend more time listening to the children.

What else could be improved? I felt that asking them to design a game was a bit too specific and they were really hung up on the fact it was a game rather than the creative activity and come up with something new.

Maybe ask them to come up with new play patterns or a new game mechanic. Could they play a not virtual game prototype to save time?
Appendix

It would be good to ask them to play other games with similar interfaces and get them to work on improving aspects of it.
8.3.5 Interview Template

History Game: Class session with St Andrews Cathy Grundy

**MENU SCREEN**
- Choose a character
  - Click on a grave?
- Choose a land?
- Choose a time?

**START SCREEN**
- Character is Nude?
  - or no armour
- Character is a baby?

**MOVE**
- Time machine
  - Map of lands
- shop to get historical things for their home
- fact lab/quiz
  - to learn about history and earn extra points
- sneak some history in here??
- Magic historical objects in a museum or round about
- Magic potions

**PROGRESS**
- Character earns weapons and armour from coins/ shop?
- disguises
- get allies for a war. Have to find out are people allies or enemies?
- just solo fight or part of a mission?
- social element?
- missions e.g capture a castle or ship to next level
- Power ups from magical sword or defeating enemy
8.3.6 Alternative Game Engines

‘Wild Knowledge’,

WildKnowledge (www.wildknowledge.co.uk) are a company providing software tools to create applications for learning on location. The product originated from research associated with the ambient wood project and the study of natural phenomena. The user-generated content (UGC) is enabled through their toolkits allowing educators to create their own projects. WildKnowledge (WK) began in 2004 as a research project (WildKey) at Oxford Brookes University. The project examined whether mobile devices, would provide a more engaging way of identifying and recording wildlife. The content has the potential to work on a range of devices e.g iphone, android and web browsers. The platform would be ideal for creating school-based field trips or adding expert information to map points, however, it has limited possibilities for the gamification of the information finding process and involving children.

3.1.1.1 Playmaker.

Scramboo offer Playmaker, a publishing platform for LBG’s, primarily used to make treasure hunts or information trails, allowing the addition of a range of media. It’s possible to allow users to choose where to go or prescribe their route. Gamification qualities are included with the addition of challenges at a given point, e.g. a quiz or task. The games are browser based and do not require a downloaded App, as with some platforms. It was used by WWF to create the ‘Waterside Challenge’. The platform offers the potential for younger people to create simple games, however, there appears to be a dependency on text entry and it would not be easily possible to make an ‘adventure’ game format, where there a narrative and conditional aspects to game progress. New developments towards AR on location within the game engine would render new possibilities but were not fully implemented at the time of writing. Playmaker, at the time of writing, is somewhat limited compared to the greater functionality of ARIS.
3.1.1.2 TaleBlazer

TaleBlazer is an augmented reality (AR) software platform that allows users to play and make their own location-based mobile games. It was developed by the MIT Scheller Teacher Education Program (STEP) lab. The first of their AR games, Environmental Detectives (ED), was described in Chapter 2.2. Their latest research in collaboration with the Missouri Botanical Garden explores the application of AR technologies in an informal learning setting, aimed at engaging youth and their families. At the time of the co-design activities this was not available, however future research should consider its potential, however it still lacks the functionality required by the adventure game genre, such as picking up and creating an inventory of objects, offered by ARIS.
SCHOOL OF COMPUTING, ENGINEERING & MATHEMATICS ETHICS FORM

This ethics form is designed to help you quickly and easily identify how you should approach any ethical issues raised by your project or dissertation. It should be completed for ALL research projects and dissertations prior to the commencement of the project. Please do not approach any participants involved in the research until this has been completed and discussed with your supervisor or member of the CEM ethics committee (if appropriate). This form must be completed by the project student or researcher responsible for the project. Once completed, you should discuss it with your supervisor to ensure that you take the right follow-up actions.

If you answer ‘No’ to all questions in this form and this is confirmed with your supervisor (if appropriate) then no further action is required. Please note that in signing this form you accept that it is still your responsibility for your project or dissertation module to follow the University’s Guidance on Good Practice in Research Ethics and Governance, available on StudentCentral. Any significant change in the question, design or conduct of your project or dissertation that would alter your answers on this form must be notified to your supervisor who will advise you on whether you need further action.

If you have answered ‘yes’ to any of the questions in Section B of the Student Checklist your supervisor will need to make a judgment as to whether or not the research includes more than a minimum level of risk. If this is the case then your supervisor will need to email this form to the CEM ethics committee (CEMethics@brighton.ac.uk) for discussion prior to the commencement of research. This does not mean that you will not be able to do the research, but it will need to be considered by the School Research Ethics and Governance Committee. Ethics forms, example consent forms/participant information sheets and supporting guidance are available on the Research Ethics for Projects – CEM area of StudentCentral. Signed copies of this completed ethics form must be submitted with your project or dissertation. Note: the project or dissertation will not be marked if the completed checklist is not included.

PROJECT DETAILS

1. Name of researcher/s: Catherine Grundy
2. Name of supervisor (if appropriate): Lyn Pemberton, Richard Morris
3. Title of project:
Digitally Enhanced Adventures to Motivate Children about Nature
4. Outline of the research (up to 100 words):
The research project explores the relationship between children, digital technologies and nature. It is being conducted with the cooperation of the Sussex Wildlife Trust. In particular it examines the assumption that playing a digitally enhanced outdoor adventure game can positively influence an early adolescent’s engagement with nature. The project will explore how this assumption can be tested and aims to identify a suitable game model and interface for experimentation. However, the optimization of the game in general will not be a parameter to be tested within the investigation, as this could be considered a ‘wicked design problem’. Rather, the parameters to be explored particularly relate to the characterization and narrative structure forming part of the adventure. Other aspects of the research will include classroom workshops to consider the methods being used for a range of applications, including working with local games companies.
5. Timescale and date of completion: January 2016.
6. Location of research: Stanmer Park and School Classrooms
7. Course module code for which research is undertaken (if appropriate): n/a
8. Email address: c.grundy@brighton.ac.uk
9. Contact address: Watts Building, Lewes Road, Moulsecoombe, Brighton
Home: 12 Alpine Road, Hove, BN3 5HG
10. Telephone number: 07961 413066
<table>
<thead>
<tr>
<th>1.</th>
<th>Does the study involve participants who might be considered vulnerable due to age or to a social, psychological or medical condition? (e.g. children, people with learning disabilities or mental health problems, but participants who may be considered vulnerable are not confined to these groups).</th>
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<td><strong>Yes</strong></td>
<td><strong>No</strong></td>
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If yes then provide details of any such participants. See the University’s ‘Guidance on Good Practice in Research Ethics and Governance’ for more details.

This research involves children between the ages of seven to 15 who will have already chosen to attend Sussex Wildlife Trust workshops either in the field or the classroom (or their parents will have chosen to send them). Thus, though specific permissions associated with the research will be necessary (detailed in this form) the activities and tasks required of the children do not put them at any greater physical or emotional risk during the activity than the workshop would have originally demanded.

The project will also include classroom activities for a similar age group organized through schools directly. This should not present a physical risk beyond normal classroom work. These activities will be creative in their nature and, though the topic is not considered particularly sensitive in this case, designed to avoid any possible negative emotional responses. Tasks would involve play, creating stories and developing characters for games, whilst also providing the child with an opportunity to give their opinion about a related design topic more generally. Research has shown that these kind of activities actually diffuse sensitivity around the discussion of subjects that could potentially be worrying (for example, separation from parents during outdoor play).

The design activities will never be conducted with one child as an individual. The smallest group size would be two children to avoid any feelings of intimidation (and to get better results from the work).

Children are particularly responsive to rewards, and a signed paper certificate will be given to any child that has participated. They will also be able to see the results of their sketches online, if they consent to their publication.

Note: proposals involving vulnerable participants are often likely to require ethical approval from the Faculty of Science & Engineering Research Ethics and Governance Committee (FREGC).

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<tr>
<th>2.</th>
<th>Will photographic or video recordings of research participants be collected as part of the research?</th>
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<td><strong>Yes</strong></td>
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If yes then please outline consent and data protection procedures (e.g. interviews cannot be overheard, details will not be accessible to others), for the use of participants’ images. Example consent and information forms can be found on StudentCentral and see guidance on data collection at the end of this document.

A request to consent for photography and video recordings will be included as an addendum to the usual permission forms distributed by Sussex Wildlife Trust. This is alongside a request for consent to include relevant data gathered during the workshops in the research findings. Similarly, parents of school children will be asked for their consent to the use of photography prior to activities in schools.

Any videos created will usually be of creative activities in groups and will not be personal interviews.

In some cases, the children will be creating the videos themselves. Clear behavioural guidelines around the privacy of other children will be provided beforehand.

The material will totally confidential and will not be used outside of the research project findings, unless specific permission is granted. In this case the anonymity of the child will always be protected.

If your data will not be confidential and anonymous then outline the justification for this decision here and procedures for mitigating against potential harm.

..............................................................................................................................................................................
Please tick the appropriate box and answer the questions where appropriate.

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<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
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<tr>
<td>3. Does the study require the co-operation of an individual to gain access to the participants? (e.g. a teacher at a school or a manager of sheltered housing)</td>
<td>Yes</td>
<td>No</td>
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<tr>
<td>If yes then describe the procedures that will be put in place to ensure safe and ethical direct involvement of human participants. Where necessary and as appropriate, include comments on obtaining informed consent, reducing harm, providing feedback, and accessing participants through an individual providing information such as a teacher/lecturer, manager, employer etc. Example consent and information forms can be found on StudentCentral. For Sussex Wildlife Trust Fieldwork and Outreach activities, the learning coordinator will be operating within their usual working environment, and as such will be at no greater physical risk than usual. For School activities, the usual level of physical risk applies to the teacher and teaching assistants involved. For both coordinator types, consent to the project will always be requested and an introductory talk outlining the aims, purpose, timescales, their expected role if any and intended outcomes of a session will be given before any activity. The consent of the Headmaster and the individual teacher has been sought for the school projects in this case. Consent forms will be distributed to parents via the normal school mechanisms before the outset of any activity. The children will also be given an introduction to the activities and the purpose behind them. They will be given opportunity to participate or opt out if preferred.</td>
<td>Yes</td>
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<td>4. Will the participants be asked to discuss what might be perceived as sensitive topics (e.g. sexual behaviour, drug use, religious belief, detailed financial matters) or could participants experience psychological stress, anxiety or other negative consequences (beyond what would be expected to be encountered in normal life)?</td>
<td>No</td>
<td>Yes</td>
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<tr>
<td>If yes then describe the procedures that will be put in place to ensure safe and ethical direct involvement of human participants. Where necessary and as appropriate, include comments on obtaining informed consent, reducing harm, providing feedback. Example consent and information forms can be found on StudentCentral.</td>
<td>Yes</td>
<td>No</td>
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<td>5. Will individual participants be involved in repetitive/prolonged testing or vigorous physical activity, experience pain of any kind, or be exposed to dangerous situations, environments or materials as part of the research?</td>
<td>Yes</td>
<td>No</td>
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<td>If yes then describe the procedures that will be put in place to ensure safe and ethical direct involvement of human participants. Where necessary and as appropriate, include comments on obtaining informed consent, reducing harm, providing feedback. Example consent and information forms can be found on StudentCentral.</td>
<td>Yes</td>
<td>No</td>
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<td>Children will be participants in Holiday Club activities or school outreach projects that are already organized by the Sussex Wildlife Trust. Parents sign a consent form designed by the Trust to allow their children to join in the activities. For this research, participants will not be exposed to any dangers beyond those expected for existing activities. A further consent form will be included to gain consent to their involvement in the research, however as previously described.</td>
<td>Yes</td>
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<td>Please tick the appropriate box and answer the questions where appropriate.</td>
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<td>6.</td>
<td>Will members of the public be <strong>indirectly involved</strong> in the research without their knowledge at the time? <em>(e.g. covert observation of people in non-public places, the use of methods that will affect privacy).</em></td>
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<td>If yes then provide brief details here <em>(e.g. how they will be involved and, where known, the age, gender, ethnicity and location of those who will be indirectly involved).</em></td>
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<td>Provide details of any negative impacts members of the public will be likely to face and that would not be considered minimal impacts <em>(e.g. invasion of privacy, harm to property, being subject to what an individual perceives to be inappropriate behaviour).</em> Describe the risks and if appropriate explain why you believe they are only minimal.</td>
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<td></td>
<td>Describe any procedures that will be put in place to ensure safe and ethical indirect involvement of members of the public <em>(e.g. providing information and feedback if requested by the public).</em> Examples of participation information forms can be found on StudentCentral.</td>
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<td>7.</td>
<td>Does this research include <strong>secondary data</strong> that may carry personal or sensitive organisational information? <em>(Secondary data refers to any data you plan to use that you did not collect yourself, e.g. datasets held by organisations, patient records, confidential minutes of meetings, personal diary entries).</em></td>
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<td>If yes then provide details regarding any secondary data to be used that may carry sensitive personal or organisational information.</td>
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<td></td>
<td>If secondary data CEMs containing sensitive personal or organisational information are to be used, outline how such use will be ethically managed <em>(e.g. details such as anonymising data CEMs, ensuring protection of source agency, gaining consent of data owners, and how the data will be stored).</em> See guidance on data collection at the end of this document.</td>
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<td>8.</td>
<td>Is this research likely to have significant <strong>negative impacts on the environment</strong>? <em>(For example, the release of dangerous substances or damaging intrusions into protected habitats.)</em></td>
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<td>If yes then provide details of these impacts here <em>(for example the release of dangerous substances or damaging intrusions into protected habitats)</em> and Describe how you will mitigate against significant environmental harm and manage risks.</td>
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<td>9.</td>
<td>Will any participants receive <strong>financial reimbursement</strong> for their time? <em>(excluding reasonable expenses to cover travel and other costs).</em></td>
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Please tick the appropriate box and answer the questions where appropriate.

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</table>

If yes then provide details and a short justification (e.g. amounts and form of reimbursement).

|……………………..……………………..……………………..……………………..……………………..……………………..………………|
|……………………..……………………..……………………..……………………..……………………..……………………..………………|

10. Are there any other ethical concerns associated with the research that are not covered in the questions above?  

Yes

If yes then give details here.

Some parents or children may be concerned about the ethics of including technology with natural settings and feel that hands on approaches to nature are more appropriate. Care must be taken to justify the activities and inform parents that cameras, videos and mobile phones are commonly used artefacts within these settings in any case.

All Undergraduate and Masters level projects or dissertations in the School of CEM must adhere to the following procedures on data storage and confidentiality.

All data should be encrypted and stored securely. Documentation should be kept in a locked cabinet or desk, and electronic data should preferably be kept on a removable disk or data stick which can be locked away, or if this is not possible on a password protected computer. Confidential and sensitive data should not be emailed unless it is encrypted or password protected since emails are centrally archived.

For Undergraduate/Masters projects, normally only the student and supervisor will have access to the data (see the University’s ‘Guidance on Good Practice in Research Ethics and Governance for further details). Once a mark for the project or dissertation has been published, all data must be removed from personal computers, and original questionnaires and consent forms should be destroyed unless the research is likely to be published or data re-used. If this is the case a justification for this should be included where appropriate in this form and in the relevant consent and participant information forms.

Student: Please sign below to confirm that you have completed the Ethics form and will adhere to these procedures on data storage and confidentiality.

Signed (Student): ………………………………………………………
Date: ………………………………………………………

Supervisor: I confirm that the research does/does not (delete as applicable) include more than a minimum level of risk.

Signed (Supervisor): ………………………………………………………
Date: ………………………………………………………

Note: If the supervisor judges that there is more than the minimum level of risk then your supervisor will need to email this form to the CEM ethics committee (CEMethics@brighton.ac.uk) for discussion prior to the commencement of research.
Appendix Items Relating to Chapter 4:

8.4 Phase 1:

8.4.1 Parent Information Sheet: Survey.
8.4.2 Child Information Sheet: Survey.
8.4.3 Survey Consent Form.
8.4.4 Survey Results.
8.4.5 Parent Information Sheet: Holiday Clubs.
8.4.6 Holiday Club Research Participation Consent.
8.4.7 Semi-structured Interview with SWT staff template.
8.4.8 Questionnaire for Children.

8.5 Phase 2:

8.5.1 CAS: Child Information Sheet.
8.5.2 CAS: Parent Information Sheet.
8.5.3 CAS Consent Form.
8.5.4 CAS Work Template St Andrews.
8.5.5 CAS Work Template Fairlight.
8.5.6 CAS Characters.
8.5.7 CAS Stories St Andrews.
8.5.8 CAS Stories Fairlight.
8.5.9 Photography Instructions.
8.5.10 Photography Results.
8.5.11 Full list of Issues.
Appendix

Parent Information Sheet: Survey about Outdoor Play. Sussex Wildlife Trust and University of Brighton Project

Introduction:
This project is about encouraging outdoor play and learning about nature. It is being done in conjunction with Sussex Wildlife Trust and the University of Brighton. It is part of a wider programme of research including the study of Location Based Games.

The children will be asked to complete a straightforward survey that will ask them about their favourite outdoor activities, their usual preferred types of play and their preference for natural creatures and plants.

Safety:
Cathy Grundy and Kate Howland, the academic involved is fully DBS checked. You will need to fill in the enclosed consent form if you agree to allow your child to participate and sign separately if you allow them to be photographed in the process. These are separate permissions, you do not need to consent to Photography or Video to take part. Please feel free to contact Cathy Grundy (07961413066) If anything is unclear and you wish for more information.

What is the purpose of the activity?
The main purpose is to do find out more about the children and their preferences to inform the design of Location Based Games that will encourage outdoor play. It forms part of a PhD study and will be used to inform research carried out in connection with a wider study based on the requirements of children.

Does my child have to take part?
‘No. It is up to you and your child to decide. Your child is also free to withdraw at any time. A decision not to take part, will not affect them. The children will be occupied for an hour. The survey should be quite enjoyable for them, but they do not have to do it.

What will happen to the results of the research study?
- Photographs or video footage will not be used if you indicated otherwise and will be destroyed.
- Photographs or video footage will only be used for research purposes and will be stored securely if you selected this option.
- Information in the form of survey results may be used in a final dissertation and may also be viewed by PhD supervisors at the University of Brighton, Lyn Pemberton and Richard Morris.
- Any research data will be destroyed after 7 years and stored in the interim securely.

We hope that your child will enjoy taking part in the study should you choose to give permission and that they will learn new skills alongside understanding more about University life.

Thanks for taking the time to read this form.
Child Participant Information Sheet: Survey.
University of Brighton, and Sussex Wildlife Trust Project

Introduction:

In this activity, you will be asked to fill in an online survey that will tell us more about how much you enjoy visits to the countryside and what you like to do there.

You will be working with the University of Brighton, and Sussex Wildlife Trust, who are a local nature charity. This is a study to help to encourage children to play outdoors in nature.

Cathy Grundy, the person involved is fully DBS checked, this is a document that shows they are suitable to work with children.

When:
This will take place in your normal ICT class, under the supervision of your normal teacher.

Do you have to take part?
No. It is up to you to decide. You are free to withdraw at any time. A decision not to take part will not affect you. It doesn't matter if you cannot do any of the activities, if you do take part, the main thing is to do your best.

What will happen to the results of the research study?
- You and your parents can decide if photographs or video footage are allowed and if they are to be used for research purposes.
- Information in the form of the finished survey will be used in a research report, called a ‘thesis’.
- Any information will be destroyed after 7 years and stored in the securely.

Thank you for reading this. You are free to join in if your carers also agree, you are also allowed not to participate if you or your carers prefer. You can also stop being involved at any time.
Appendix

Consent Form

Title of Project: Survey about Outdoor Play

Name of Researcher: Cathy Grundy (University of Brighton)

Please read the enclosed information sheet and if you agree to your child participating in this exciting project:

• add your name and your child’s name at point 1.
• Sign the photography consent at point 5 if you agree to it
• Finally sign the form at the bottom. Thank you.

1. I ______________________________________________________ agree that my child can be involved in this project.

2. I have been informed of the nature and purposes of the study and have read the information sheet.

3. I am aware that my child will be asked to give their opinion and preferences about nature, usual play types and their behaviour in relation these activities. I give my permission for Cathy Grundy to use excerpts from the survey involved.

4. I understand that participation is voluntary and that my child is free to withdraw at any time without repercussion.

5. I give permission for photography to be taken of my child and understand that they will be used by the researchers involved for research purposes only.

* Yes / No
* Please delete as appropriate

6. I understand that personal details, images, video and photography will remain confidential. Data will be stored in a secure area and destroyed after 7 years.

7. I understand that the data collected will be used as part of a dissertation project. I understand that the data will be used in writing up and disseminating research (including in a dissertation which will be held in the School of the Computing, Engineering and Mathematics, University of Brighton). I understand that only anonymous excerpts from the research will be used in this write up.

__________________________________       ________________     ___________________
Name of Participant                        Date                             Signature

__________________________________       ________________     ___________________
Name of Parent                             Date                             Signature

__________________________________       ________________     ___________________
Researcher                                 Date                             Signature
8.4.4 Results: Phase 1 ii) Survey

IC 14.3 How much time is spent in the countryside?
- 11% Had never visited.
- A further 7% had only been once.
- A further 26% only visited twice in a year.
- Just over half the group visited monthly or more.

IC 14.4 Do they know what the benefits are?
96% of the children said that children should go to the countryside and 93% said children should learn about nature.

Table Error! No text of specified style in document.-1 Table showing response to reasons for outdoor play

The reasons were given (in order): 79% thought it was important ‘to get fresh air’; 68%, to get exercise; to see or learn about nature was 61%; to appreciate the environment was 54% and to make children feel good 46% (shown in Figure 4.2.6-1)

Why do they go? ‘Camping’ (51%) was the most likely reason they had visited the country, followed by ‘meeting up with friends or relatives’ (50%); ‘country walks’ were also cited (39%). 84% of the time the visits were initiated by parents; only very few of this sample had been to nature clubs offered by SWT or other organizations.

IC14.1 What kind of predisposition do the children have to being in a natural environment?
In terms of how keen they were to be there, 30% said that ‘they always wanted to go when asked’, 41%, the highest percentage, said ‘visiting was ok if they had nothing else to do’, 26% ‘avoid it but like it once there’. Only 3% said that they never want to go.

IC14.4 What do children in this age range prefer to do with their time?
Appendix

The children were asked to drag preferred activities into their chosen order. The questions were intended to evaluate indoor vs outdoor activity and how friends or social aspects influenced their preference. They were also given opportunity to describe alternatives. The results are not quantitative but are relative to each other in status.

![Bar chart showing children's preferred activities](image)

Playing games with friends figured most highly, represented in three categories, including online games, a board game or any other type of game. Interestingly, the children all said that outdoor activities, either at the country, the local park or the beach were of more interest to them than playing games indoors or watching TV. However, playing games on a mobile was quite low in popularity. When asked what kind of computer game genre they liked, Adventure games came top, followed by Driving or speed games; ‘shoot em up’ games came next but less than half the number of children were likely to choose them, compared with adventure games.

**IC14.5 What are their favourite outdoor activities?**

The diagram in Figure 4.2.6-2 illustrates their preferences for games played in the countryside, the categories were generated from findings in the literature review. The physical challenges came top of the list, with Treasure Hunts also scoring highly, alongside shelter making and the use of media like photography and video. Creative
activities came lower down in the hierarchy along with ‘lighting fires’. Making weapons was also low and bug hunting came so low it figured in ‘other’.

![Bar chart](chart.png)

*Figure Error! No text of specified style in document.*

*Figure 2 Children’s preferences for outdoor activities.*

When asked for a written response about what might encourage them to play in nature, the answers fell into three main categories:

- food (toasting marshmallows or a pub lunch were quoted)
- friends going with them
- how it made them feel

### IC3 What kind of natural content, e.g. animals, insects etc. are preferred?

The children were asked to place in order of preference natural objects, taken from top-level classifications of nature, by the Collins guide. The lower the number the more preferred the phenomena were. Favourite natural things, in order were: animals (45% placed this first) rating 2.9; birds 4.2; trees, rating 5.79; plants rating 5.9; flowers rating 6.9; fish rating 6.59; insects rating 8.55. For the environment, they chose the following: rivers 4.86; the sea 5.93; general countryside environment 6.38; mountains 6.86. Interestingly, as a feature, mud was a love or hate thing: 10% put it first, 21% put this second overall rating 5.28, but 30% disliked it the most, with the overall result
producing quite an average score. They were also asked to place their least favourite phenomena in order. The order here was: nettles, wasps, spiders, insects in general, worms, the weather, mud, wild animals and birds.

IC1.2 What are children afraid of?

A written response (to avoid prompting them) revealed fear of:

- extreme weather (lightening or being caught in the rain)
- insects
- large animals such as cows
- snakes
- getting lost.
Participant Information Sheet: Holiday Clubs, Sussex Wildlife Trust and University of Brighton Project

Introduction:
This project is about the children enjoying outdoor play and learning about nature. It is being done in conjunction with Sussex Wildlife Trust and the University of Brighton. It is part of a wider programme of research, including the study of Location Based Games and also how to use technology to get children to play outdoors.

The children will be taking part in the normal activities that you have signed up for with the Sussex Wildlife Trust. However, they will also be observed by the academic and notes will be made about the nature of the activities and how enjoyable they seem to be to the children.

Safety:
Cathy Grundy and the SWT staff involved, are fully DBS checked. You will need to fill in the enclosed consent form if you agree for your child to participate in the wider research being conducted and sign separately if you allow them to be photographed in the process. This will not affect their ability to take part in the Susse Wildlife Trust Holiday Clubs. These are separate permissions, you do not need to consent to Photography or Video to take part and images will be used for research only.

The Sussex Wildlife Trust will explain the usual safety procedures for playing in Stanmer Park and will follow the normal protocols to keep the children safe.

Please feel free to contact Cathy Grundy (07961413066) if anything is unclear and you wish for more information.

What is the purpose of the activity?
The main purpose is to learn about the preferences of children for nature and the kind of activities they enjoy in the countryside.

Does my child have to take part?
‘No. It is up to you and your child to decide. Your child is free to withdraw at any time. A decision not to take part, will not affect them. The children will be occupied for an hour. They will be shown a series of historical characters and objects and environments and will be making up stories about them. This should be very enjoyable for them, but they do not have to do it.

What will happen to the results of the research study?
- Photographs or video footage will not be used if you indicated otherwise and will be destroyed.
- Photographs or video footage will only be used for research purposes and will be stored securely if you selected this option.
- Information in the form of images, sketches or write-ups of the discussions will be anonymous and may be used in a final dissertation and may also be viewed by PhD supervisors at the University of Brighton, Lyn Pemberton and Richard Morris.
- Any research data will be destroyed after 7 years and stored in the interim securely.

We hope that your child will enjoy taking part in the study should you choose to give permission and that they will learn new skills alongside understanding more about University life.

Thanks for taking the time to read this form.
Consent Form

Title of Project: Research Observations of Sussex Wildlife Trust Holiday Clubs

Name of Researcher: Cathy Grundy (University of Brighton)

Please read the enclosed information sheet and if you agree to your child participating in this exciting project:

• add your name and your child’s name at point 1.
• Sign the photography consent at point 5 if you agree to it
• Finally sign the form at the bottom Thank you.

1. I ______________________________________________________ agree that my child can be involved in this project.

2. I have been informed of the nature and purposes of the study and have read the information sheet.

3. I am aware that my child will be asked to participate in discussions about nature. I give my permission for Cathy Grundy to use excerpts from the discussions involved.

4. I understand that participation is voluntary and that my child is free to withdraw at any time without repercussion.

5. I give permission for photography to be taken of my child and understand that they will be used by the researchers involved for research purposes only.

* Yes / No
* Please delete as appropriate

6. I understand that personal details, images, video and photography will remain confidential. Data will be stored in a secure area and destroyed after 7 years.

7. I understand that the data collected will be used as part of a dissertation project. I understand that the data will be used in writing up and disseminating research (including in a dissertation which will be held in the School of the Computing, Engineering and Mathematics, University of Brighton). I understand that only anonymous excerpts from the research will be used in this write up.

Name of Participant __________________ Date __________________ Signature __________________

Name of Parent __________________ Date __________________ Signature __________________

Researcher __________________ Date __________________ Signature __________________
Appendix

8.4.7 Template for Semi-Structured Interviews with Nature Experts and SWT staff:

- About the interviewee:
  - Current job role with trust
  - Past & other experience
  - How long?
  - Qualifications background
  - Philosophy
  - Corporate philosophy
  - Attitude to children & nature
  - Outreach
  - Holiday clubs

- Marketing & comms:
  - Courses
  - Social online
  - Online
  - Interaction
  - Websites

- Organization:
  - Mugs

- Wildlife expert views 'say':
  - Use of technology
  - Attitudes to the use of technology

- Children:
  - Gender?
  - What stops them
  - What motivates them

- Parents:
  - What motivates them

- Anything else?

- Future directions:
  - Funding
  - Aims

- Key facts about nature?
## Appendix

### 8.4.8: Children’s Questionnaire for Holiday Clubs

For each activity, tick the smiley face that is closest to how much you enjoyed it:

<table>
<thead>
<tr>
<th>Write the Name of the Activity:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Awful</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Write the Name of the Activity:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Awful</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Write the Name of the Activity:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Awful</td>
</tr>
</tbody>
</table>
Appendix

<table>
<thead>
<tr>
<th>Write the Name of the Activity:</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Emojis](Awful, Not very good, Okay, Really good, Fantastic)</td>
</tr>
</tbody>
</table>

Which was your favourite activity?

Can you say why?
8.5.1: Child Participant Information Sheet: Game Design
University of Brighton, University of Sussex and Sussex Wildlife Trust Project

Introduction:

This project will be about creating games for an IPad or a phone that you can play yourselves and with other children to encourage learning about nature outdoors. You will be working with the University of Brighton, the University of Sussex and Sussex Wildlife Trust (a local nature charity). This is a study and it will help us to know more about how children can enjoy nature. You will use your creative skills to create drawings and stories about nature and learn about technology and how to create simple games. Both Kate Howland and Cathy Grundy, the people involved are fully DBS checked, which shows they are suitable to work with children.

When:
This will take place over two days and you will get lunch provided on those days.

Do you have to take part?
No. It is up to you and your parent to decide. You are free to withdraw at any time. A decision not to take part, will not affect you. It doesn’t matter if you cannot do any of the activities if you do take part, the main thing is to do your best. The game design should be very enjoyable but you do not have to do it.

What will happen to the results of the research study?
- You and your parents can decide if photographs or video footage are allowed and if they are to be used for research purposes or you are happy for it to be also used for publicity. You and your parents can make a choice about this on a different form.
- Information in the form of images, sketches or write-ups of the discussions will be anonymous.
- Any information will be destroyed after 7 years and stored in the securely.

Thank you for reading this. You are free to join in if your carers agree, you are also allowed not to participate if you or your carers prefer. You can also stop being involved at any time.
Appendix

Parent Information Sheet: Game Design, Sussex Wildlife Trust and University of Brighton Project

Introduction:
This project is about the children creating games for other children that will encourage outdoor play and learning about nature. It is being done in conjunction with Sussex Wildlife Trust, the University of Brighton and the University of Sussex. It is part of a wider programme of research that the two academics are involved with, including the study of Location Based Games and also how to use technology to get children to play outdoors.

The children will be using their creative skills to create drawings and stories about nature and they will also be learning about new uses for technology and how to create simple games for an Ipad.

Safety:
Both Cathy Grundy and Kate Howland, the academics involved are fully CRB checked. You will need to fill in the enclosed consent form if you agree to allow your child to participate and sign separately if you allow them to be photographed in the process. These are separate permissions, you do not need to consent to Photography or Video to take part and you can give permission for images to be used for research only. However, publicity shots are used for brochures and the University Official web site unless further permission is asked. Please feel free to contact Cathy Grundy (07961413066) if anything is unclear and you wish for more information.

What is the purpose of the activity?
The main purpose is to do a creative activity with the children that will introduce them to University Life If they or you have been considering a University education it will allow them to find out more. They will also be learning new skills and applying them to achieve a new games production to increase their confidence with technology and design.

Does my child have to take part?
‘No. It is up to you and your child to decide. Your child is also free to withdraw at any time. A decision not to take part, will not affect them. The children will be occupied for an hour. They will be shown a series of historical characters and objects and environments and will be making up stories about them. This should be very enjoyable for them, but they do not have to do it.

What will happen to the results of the research study?
- Photographs or video footage will not be used if you indicated otherwise and will be destroyed.
- Photographs or video footage will only be used for research purposes and will be stored securely if you selected this option.
- Photographs or video footage will only be used for publicity or marketing if you selected this option.
- Information in the form of images, sketches or write-ups of the discussions will be anonymous and may be used in a final dissertation and may also be viewed by PhD supervisors at the University of Brighton, Lyn Pemberton and Richard Morris.
- Any research data will be destroyed after 7 years and stored in the interim securely.

We hope that your child will enjoy taking part in the study should you choose to give permission and that they will learn new skills alongside understanding more about University life.

Thanks for taking the time to read this form.
Consent Form

Title of Project: Game Design project

Name of Researcher: Cathy Grundy (University of Brighton) and Kate Howland (University of Sussex)

Please read the enclosed information sheet and if you agree to your child participating in this exciting project:

- add your name and your child’s name at point 1.
- Sign the photography consent at point 5 if you agree to it
- Finally sign the form at the bottom Thank you.

1. I ______________________________________________________ agree that my

child ____________________________________________________ can be involved in
this project.

2. I have been informed of the nature and purposes of the study and have read the information sheet.

3. I am aware that my child will be asked to create drawings and stories and participate in discussions about nature. I give my permission for Cathy Grundy to use excerpts from the designs and discussions involved.

4. I understand that participation is voluntary and that my child is free to withdraw at any time without repercussion.

5. I give permission for photography to be taken of my child and understand that they will be used by the researchers involved for research purposes only.

* Yes / No

* Please delete as appropriate

6. I also give permission for photography to be used in University publications or on the University Website.

Yes/No

* Please delete as appropriate

7. I understand that personal details, images, video and photography will remain confidential.

Data will be stored in a secure area and destroyed after 7 years.

8. I understand that the data collected will be used as part of a dissertation project. I understand that the data will be used in writing up and disseminating research (including in a dissertation which will be held in the School of the Computing, Engineering and Mathematics, University of Brighton). I understand that only anonymous excerpts from the research will be used in this write up.

Name of Participant ___________________________ Date ___________ Signature ___________________________

Name of Parent ___________________________ Date ___________ Signature ___________________________

Researcher ___________________________ Date ___________ Signature ___________________________
1. Choose your favourite natural thing. It could be an animal, frog, bug or plant.

2. Describe what they look like, do you know its exact name?

3. Make a cartoon character based on your natural thing and draw them:
4. Your Character’s Personality:
What are they like, for example would they be:
a goodie or a baddie?
Are they friendly or nasty?
Shy or Confident?

5. Do they have any odd behaviors or habits?

7. Do they have any friends or enemies? What natural thing are they based on? You can draw them too if you wish.

8. Create a simple game challenge for your character in your story for a game:
Appendix 8.5.5:

1. Choose your favourite natural thing from the walk, or books. It could be an animal, frog, bug or plant. Write their name and what kind of thing they are here:

2. Make a cartoon character based on your natural thing and draw them:

4. Your Character’s Personality:
What are they like, for example would they be: a goodie or a baddie?
Are they friendly or nasty?
Shy or Confident?
Appendix 8.5.5:

8. We will brainstorm a simple game challenge for your character, based on an overall story.

In each case you can put into your game:

- A Character: An interaction with your character (place them in Stanmer Park to be found and create a conversation around your chosen story).
- Objects: These are the things you need to find as part of the story, they should be natural things.
- A plaque that tells you that you have found the location of the baddie or cured your friend at the end of the game.

9. Your story for a game: Draw some scenes for your game on the next sheets:
### 8.5.6 Table showing natural subjects chosen as characters in phase 2 i)

<table>
<thead>
<tr>
<th>Character</th>
<th>Lead</th>
<th>Support</th>
<th>Good</th>
<th>Bad</th>
</tr>
</thead>
<tbody>
<tr>
<td>Snake</td>
<td>5</td>
<td>10</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>Squirrel</td>
<td>7</td>
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<td>8</td>
<td>1</td>
</tr>
<tr>
<td>Rabbit</td>
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<td>5</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>Fox</td>
<td>7</td>
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<td>Mouse</td>
<td>4</td>
<td>3</td>
<td>6</td>
<td>1</td>
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<tr>
<td>Butterfly</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Bat</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Badger</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Tree/leaf</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Bird</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Ladybird/bug/cockroach</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Slug/snail</td>
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<td>3</td>
<td>3</td>
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<td>Hedgehog</td>
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<td>1</td>
<td>2</td>
<td></td>
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<tr>
<td>Deer</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>African Sand Spider</td>
<td>1</td>
<td></td>
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</tr>
<tr>
<td>Unidentified</td>
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</tbody>
</table>
## Appendix

### 8.5.7 Narratives St Andrews

<table>
<thead>
<tr>
<th></th>
<th>Hero</th>
<th>Personalit y</th>
<th>Friends</th>
<th>Adversary</th>
<th>Goal/motivations</th>
<th>Behavior / weapons features</th>
<th>Emotional Needs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Dalia F</td>
<td>Rabbit</td>
<td>Friendly</td>
<td>Fox</td>
<td>Get food Escape home from fox, jump hedgehogs</td>
<td>Eating carrots</td>
<td>Food and survival, Fear of foxes?</td>
</tr>
<tr>
<td>2</td>
<td>Jolyn F</td>
<td>Deer</td>
<td>Shy</td>
<td>Rabbit</td>
<td>Evil elf</td>
<td>Eat bark to get bigger &amp; stronger</td>
<td>Elf has gun</td>
</tr>
<tr>
<td>3</td>
<td>Ellis M</td>
<td>Banger the bat?</td>
<td>Cheeky</td>
<td>Foxy and rabbit are his aim</td>
<td>Play hide and seek take over Cleo the princesses hideaway</td>
<td>Flies through things</td>
<td>Be the best and in control the other animals Overcome fear of bats?</td>
</tr>
<tr>
<td>4</td>
<td>Izzy F</td>
<td>Two foxes</td>
<td>Friendly</td>
<td>Family: vanilla candy and caramel</td>
<td>Rabbit</td>
<td>To get together, look after and feed babies, move them put them to sleep etc.</td>
<td>They are good but catch rabbits! Make parties</td>
</tr>
<tr>
<td>5</td>
<td>Tatum F</td>
<td>Leaf</td>
<td>Shy</td>
<td>Mum</td>
<td>Not specified mum saves her</td>
<td>Not specified</td>
<td>Protection by parent</td>
</tr>
<tr>
<td>6</td>
<td>Daisy F</td>
<td>Fox</td>
<td>Friendly but sometimes shy</td>
<td>Badger</td>
<td>Badger and foxy make underground clubs</td>
<td>Guns from twigs</td>
<td>Control power struggles Hide in safety secrets Collaborate with friends Overcome fear bats</td>
</tr>
<tr>
<td>7</td>
<td>Freddie M</td>
<td>African Sand Spider</td>
<td>Family</td>
<td>Birds</td>
<td>A her been captured and escapes to find family again</td>
<td>Bites if threatened but usually only insects Jujitsu! Avoid dead hben B</td>
<td>BE with family Escape Win fights Overcome fear of spiders?</td>
</tr>
<tr>
<td>8</td>
<td>Scarlett F</td>
<td>Peanut squirrel</td>
<td>Shy</td>
<td>Evil coconut</td>
<td>Find cousin, with the help of friends, Avoid the yeti! And get coins Avoid the volcano and keep 20 lives.</td>
<td>Collect things find family and friends</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Tilly F</td>
<td>Skateboarding snail</td>
<td>Protects people pretend to be normal</td>
<td>Mother and baby snail</td>
<td>Rescue people Smash shell of evil snail and win fight</td>
<td>Wins fights Super skateboard skills</td>
<td>Win, be stronger, have an impact Overcome fears/dislike</td>
</tr>
<tr>
<td>10</td>
<td>Toby Fox</td>
<td>Sensible</td>
<td>&amp;Snail</td>
<td>none</td>
<td>Enters a fantasy world of nature when he becomes a fox/wears a fox suit</td>
<td>Gets super small to be part of nature</td>
<td>Escape and fantasy. Explore the world</td>
</tr>
<tr>
<td>11</td>
<td>Hedgy</td>
<td>Rabbit and Snail</td>
<td>Benjimon</td>
<td>Looking for magic diamond. Take over</td>
<td>Special scarf</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Appendix

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>Hopsy Rabbit Bird</td>
<td>Friendly but can be shy about speaking out</td>
<td>Cheesy mouse</td>
<td>Always doing important missions</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cocky the Cockroach</td>
<td>Secret codes to get into their house</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Hopsy has jumping superpower</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Bird has special blinding feathers</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Have impact in the world: Control Overcome fear of bugs</td>
</tr>
<tr>
<td>13</td>
<td>Ginger the fox (does not eat rabbits)</td>
<td>Fluffy fox (eats rabbits)</td>
<td>Evil Mousey</td>
<td>To stop the threat to their home which is under attack</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ginger can run super fast</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Protect what is theirs</td>
</tr>
<tr>
<td>14</td>
<td>Afro Tree</td>
<td>Friendly Afro tree looks after their home</td>
<td>To stop the tree fellers</td>
<td>Grows with water and dirt and can hit with branches</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Protect self and others (win?)</td>
</tr>
<tr>
<td>15</td>
<td>Bad Bird</td>
<td></td>
<td></td>
<td>Generally unreadable</td>
</tr>
<tr>
<td>16</td>
<td>Chloe Rabbit</td>
<td>Friendly and always playing</td>
<td>Ginger the Fox</td>
<td>Magically make buggie the bug nice</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Chloe is a princess who loves carrots</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Win over buggie</td>
</tr>
<tr>
<td></td>
<td>Bad Ratty</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Brenden Badger</td>
<td>Brave but not very strong</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fast</td>
<td></td>
<td>He likes to be different, do athletics and eats a lot</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Powerful character</td>
</tr>
</tbody>
</table>
### 8.5.8 CAS Results Fairlight School

1. "An evil snake is threatening the park animals and needs to be captured." The game player had to find a series of locations where he was last seen.

2. "There is a mean hawk in the woods trying to kill innocent animals". The player needs to find sharp objects from nature to fight it off.

3. "Save a sick rabbit" by making a potion out of a series of ingredients that represent objects around the park including rabbit droppings.

4. "The squirrel and friends need to beat the baddy" (a weasel spy) by finding objects to make weapons for a great battle.
Appendix

Stanmer Park Recky...
University of Sussex & Fairlight School

Instructions:

1. You should work in pairs, with 4 people (2 groups) assigned to one adult.
2. Each group will be given an iPad mini and a video camera (please look after them).
3. You will all follow the same route that will take us past some particular points of interest, or along paths that have not been walked on before - all guided for you.
4. Your brief is to find natural things that are of particular interest to you, take a photograph of them, or make an audio recording in the case of bird song (using the ARIS game application that will be explained to you). Their location should be stored automatically by this application for later use.
5. You can also take some video footage that shows more about the surroundings.
6. Try to collect things from different categories: flowers, trees, leaves, bugs, birds, animals, etc. (even if it is just leaves or berries).

Some notes on safety, this way it should be enjoyable for all:

• You should stay within eyesight of your adult at all times.
• Do not eat any natural things - e.g. berries, fungi or nuts, even if you think you know what they are (unless Kate Tiffin from the Sussex Wildlife Trust tells you to!).
• Don't pet dogs unless the owner has told you they are friendly.
• Don't climb trees or steep cliffs etc. without permission.
• Watch out for nettles and other hazards like brambles.

On the next page we have pointed out a few areas of interest and we will probably stop at the points indicated.
These are some suggested spots, we will add some more interesting places on the way, depending on what the group wants.

1. Start at the pond outside the church. What do you think might live in the murky waters? Are there any ducks or birds there?

2. Cross the road and walk to the left of stammer House. There are some lovely flowers in the grass here, can you photograph three different types? Can you name them? Record anything else you wish.

3. Further to the left towards the woods there is an amazing dead tree. What do you think might live here? What else catches your eye?

4. Into the woods. If you keep going you will see the Frankland Monument. Look around for woodland plants and any evidence of animals in the area. What trees can you find? Do you know what kind they are?

5. Deeper in the woods. Can you hear birdsong? Are you able to record any? Can you see a hazelnut bush? In autumn these feed dormice and other small mammals. Can you see any autumnal bushes in the area? Can you record anything else you want to.

These are some suggested spots, we will add some more interesting places on the way, depending on what the group wants.
### Appendix

#### 8.5.10 Photography results phase 2

<table>
<thead>
<tr>
<th>Children’s Photography Results</th>
<th>Images</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>a) Creepy Crawlies</strong>: images of what SWT term ‘mini beasts’ (9 instances, across all 4 groups). 5 of the images included the children placing them on their hand.</td>
<td></td>
</tr>
<tr>
<td><img src="image1.png" alt="Creepy Crawlies" /></td>
<td></td>
</tr>
<tr>
<td><strong>b) Animal signs</strong>: Evidence of animal ‘activity’, for example mole hills (3 instances, 3 groups), rabbit holes (2 instances, 2 groups) or badger/fox holes (2 instances, 2 groups).</td>
<td></td>
</tr>
<tr>
<td><img src="image2.png" alt="Animal signs" /></td>
<td></td>
</tr>
<tr>
<td><strong>c) Vegetation growth</strong>: signs of growth or reproduction, for example buds appearing or catkins (4 instances, 3 groups).</td>
<td></td>
</tr>
<tr>
<td><img src="image3.png" alt="Vegetation growth" /></td>
<td></td>
</tr>
<tr>
<td><strong>d) Trees (affording climbing)</strong>: a dead tree was photographed by all groups. Unusual tree growth was photographed generally, especially where it afforded climbing (6 instances across all groups).</td>
<td></td>
</tr>
<tr>
<td><img src="image4.png" alt="Trees" /></td>
<td></td>
</tr>
<tr>
<td><strong>e) Branches</strong>: 4 of the boys picked up a loose branch from different areas and used it as a staff. In the transcript of the conversation, they were talking about ‘power sticks’ and acting like wizards with a magic staff casting spells on each other.</td>
<td></td>
</tr>
<tr>
<td><img src="image5.png" alt="Branches" /></td>
<td></td>
</tr>
<tr>
<td><strong>f) Flowers</strong>: All groups included at least one flower picture (12 images). Daisies and buttercups were the most recognized.</td>
<td></td>
</tr>
<tr>
<td><img src="image6.png" alt="Flowers" /></td>
<td></td>
</tr>
</tbody>
</table>
## Appendix

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
</table>
| **g)** Subjects that stirred imagination: | Several groups (3) included a striking root system which one group described in their discussions as ‘creepy’, another ‘as if a monster might live there’. One person photographed a particularly mature ivy growth around a tree and described it as ‘strangling the tree’.
|   |   |
| **h)** Affording peeping | 4 photographs were taken where there were opportunities to peep through and not be seen.
|   |   |
| **j)** Markings and ‘secret signs’: | Images of things, both natural and synthetic, that children claimed to be ‘secret signs’ 3 instances.
|   |   |
| **k)** Subjects relating to knowledge. | Several pupils (3 instances) chose nettles and one, even though they were not stung, immediately started to look around for a dock leaf, an antidote.
|   |   |
| **l)** Visual contrast: | areas of contrast in colour, or texture were selected for photographs, for example, copper beech tree against a background of greenery (4 instances all four groups)
|   |   |
| **m)** Synthetic features: | A number of objects that were not natural were photographed, though this was not in the brief. They include visible markers like the signpost and path indication in the image.
### 8.5.10. Full List of Issues at the start of Phase 2.

**Threshold of Acceptability Questions:**

<table>
<thead>
<tr>
<th>Player/Activities/ R. Environment</th>
<th>All</th>
<th>QC2 (&amp; QC6) What kind of techniques and activities do experts employ to engage children with nature (and are suitable for older children)?</th>
<th>2/3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Player/Activities/ R. Environment</td>
<td>Reflective/ Emotional</td>
<td>QC2.1 Which of the expert activities are preferred by older children (&amp; QC8 Play Types)?</td>
<td>2/3</td>
</tr>
<tr>
<td>Player/Activities/ R. Environment</td>
<td>Physical</td>
<td>QC2.2 Which games encourage functional play?</td>
<td>2/3</td>
</tr>
<tr>
<td>Player/Activities/ R. Environment</td>
<td>Visceral</td>
<td>QC2.3 Which activities can stimulate sensory play?</td>
<td>2/3</td>
</tr>
<tr>
<td>Player/Activities/ R. Environment</td>
<td>All</td>
<td>QC2.4 Which other types of play work in this environment?</td>
<td>2/3</td>
</tr>
<tr>
<td>Player/Activities/ R. Environment/ V. Environment</td>
<td>All</td>
<td>QC8 what kind of activities and play types may be transferable to the game environment?</td>
<td>2/3</td>
</tr>
<tr>
<td>Player/Activities/ R. Environment/ V. Environment</td>
<td>Physical</td>
<td>QC 9 (&amp; QC3) What level of physical (&amp; cognitive) challenge is appropriate for children of this stage?</td>
<td>3/4</td>
</tr>
<tr>
<td>R. Environment/ V. Environment/ Activities</td>
<td>Physical</td>
<td>QG 8 (QG7) What kind of duration should the game and activities be in this terrain?</td>
<td>3/4</td>
</tr>
<tr>
<td>Player/Activities R. Environment/ V. Environment</td>
<td>Behavioural</td>
<td>QC 10 (QC3) Which activities meet an appropriate threshold of cognitive demand? QC10.1 Which activities are easily understood when a guide is not present?)</td>
<td>3/4</td>
</tr>
<tr>
<td>Real Environment/ Virtual Environment</td>
<td>All</td>
<td>QG6 How does GPS reliability and other technical constraints impact on the experience of play specifically in natural environments?</td>
<td>3/4</td>
</tr>
</tbody>
</table>

**Key Questions**

| Player/all dimensions | Emotional | QC12, QG12. How can the emotional needs of children be predicted and addressed for this context, to increase volition? | 2/3/4 |
**Chapter 8 Appendix**

<table>
<thead>
<tr>
<th>Player/all dimensions</th>
<th>Emotional</th>
<th>QG13. What are the properties of the game that address the need for control?</th>
<th>3/4</th>
</tr>
</thead>
<tbody>
<tr>
<td>R. Environment/ V. Environment/ Activities</td>
<td>Emotional</td>
<td>QC 13. What are the properties of the game that address the need for independence?</td>
<td>3/4</td>
</tr>
<tr>
<td>Player/all dimensions</td>
<td>Emotional</td>
<td>QG14. How can the game impact challenge and feelings of competence for this context?</td>
<td>3/4</td>
</tr>
<tr>
<td>V. Environment/ Characters</td>
<td>Relational</td>
<td>QC7 What kind of characters and narratives do children of this age relate to?</td>
<td>3/4</td>
</tr>
<tr>
<td>V. Environment/ Characters</td>
<td>Relational</td>
<td>QG10 How can a social dimension be safely included in an LBMG?</td>
<td>3/4</td>
</tr>
<tr>
<td>R. Environment/ V. Environment/ Objects</td>
<td>Behavioural/ Emotional</td>
<td>QCS 8 What kind of game rewards give appropriate feedback?</td>
<td>3/4/5</td>
</tr>
<tr>
<td>R. Environment/ V. Environment</td>
<td>All</td>
<td>QG3 What are the qualities of LBMG’s that can help to increase awareness of the environment?</td>
<td>3/4/5</td>
</tr>
<tr>
<td>R. Environment/ activities</td>
<td>All</td>
<td>QG3.1 Which activities help to encourage interaction and immerse the player in the environment?</td>
<td>3/4/5</td>
</tr>
<tr>
<td>R. Environment/ V. Environment/ Activities</td>
<td>Visceral</td>
<td>QCS1 How can attention be managed to create a balance between worlds, enabling connection with place?</td>
<td>3/4/5</td>
</tr>
<tr>
<td>Player/ R. Environment</td>
<td>Visceral</td>
<td>QCS1.1 Which features of a natural landscape draw the player’s attention (through visibility)?</td>
<td>3/4</td>
</tr>
<tr>
<td>Player/R. Environment/ Activities</td>
<td>Behavioural</td>
<td>QCS1.2 Which features of a natural landscape provide feedforward to guide the player’s interaction?</td>
<td>3/4</td>
</tr>
<tr>
<td>Player/R. Environment/ Activities</td>
<td>Reflective</td>
<td>QCS1.3 Which features of a natural landscape are meaningful to the child (have affordance)?</td>
<td>3/4</td>
</tr>
<tr>
<td>R. Environment/ V. Environment/ Activities</td>
<td>Behavioural/ Visceral</td>
<td>QG14.1 Can children use a google terrain map?</td>
<td>3</td>
</tr>
<tr>
<td>R. Environment/ V. Environment/ Activities</td>
<td>Behavioural/ Visceral</td>
<td>QG14.2 What kind of visual cues are necessary within the game to support wayfinding?</td>
<td>3/4/5</td>
</tr>
</tbody>
</table>
### Chapter 8 Appendix

<table>
<thead>
<tr>
<th>R. Environment/V. Environment/Activities</th>
<th>Behavioural/Visceral</th>
<th>Behavioural/Emotional</th>
<th>Questions</th>
<th>Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td>R. Environment/V. Environment/Activities</td>
<td>Behavioural/Visceral</td>
<td>Behavioural/Emotional</td>
<td>QG11. What kind of wayfinding tools are appropriate for the audience and what is their relationship with reality?</td>
<td>4/5</td>
</tr>
<tr>
<td>All</td>
<td>Behavioural</td>
<td></td>
<td>QC 11 How do certain media types address the cognitive abilities of the child for this environment?</td>
<td>3/4/5</td>
</tr>
<tr>
<td>All</td>
<td>Behavioural</td>
<td></td>
<td>QCS 7 How can the game direct players to locations through preferred media?</td>
<td>4/5</td>
</tr>
</tbody>
</table>
Introduction

In this session we are going to work on stories for a game and adding natural objects.

1. Activity 1: choose a story for a game and add some activities

1. A wizard needs to make a magic potion to cure your animal friend. What natural objects would they need to find to make into a potion? Draw some natural objects you would include in the game in the boxes on the next page:

2. A baddie is trying to take over the forest and you need to get superpowers in order to defeat them? What natural objects could you eat and what superpower do they give you?

3. Your friend has been kidnapped by an evil weasel and you need to track them and find signs in the wood to follow them. What signs e.g. certain flattened bushes, mole hills, tracks, poo (!) etc. would you look for to follow them?

4. Your animal friend has had their house destroyed by evil snake and they just escaped in time. What natural objects could you use to create a new home for them that will protect them? Draw some ideas in the storyboard sheet.

5. You want to make a work of art or a sculpture to take to a friend’s birthday party. What might you make it from?
2. Activity 2:  Choose a natural character, either your original drawing or a photo. Animate them in Morfo to tell the player what to do for your game level.

3. Questions:

If there were a series of missions like this, how would you like to be rewarded in the game?

Tick one or describe your own...

1. Collect a character to be your friend in the game or for another online game?

2. Collect points or coins so that you get a score to compare with others?

3. Have a ‘power up’ of your character so that it gets different qualities and can compete with other players in an online game.
### 8.6.2 Objects Chosen after story selection phase 3.

<table>
<thead>
<tr>
<th>Story Chosen</th>
<th>No.</th>
<th>Objects Chosen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Build a new home</td>
<td>6</td>
<td>Tree trunks, for the main house (x3), with twigs, horse chestnut, ‘wood’, hazel, for making structures; silver birch and blackthorn for furniture; leaves (x4) and blossom for cover. Two included bamboo, there were perhaps unaware this did not occur naturally in the UK.</td>
</tr>
<tr>
<td>Get superpowers</td>
<td>9</td>
<td>Superpower items include: a snakes tongue that would give you poisoning ability or a poison fang; a slug or a snail that gives slime power (x3), or a snail shell that protects you, a ladybird who gives you spots to hypnotize people, palm trees that make you prickly, rabbit droppings to give you super breath (x2), holly to give superspikes, poisonous berries to give poison power, campfire power and grass to create a grass storm, a red rose petal that is a love drug, wings of a ladybird</td>
</tr>
<tr>
<td>Curing a friend through magic</td>
<td>10</td>
<td>Fruits (x 3); acorns, leaves (x2), flowers (to make it smell nice), bark, berries, elder (x2), hawthorn, silver birch, holly (x2), hazel, horse chestnut, wild cherry (x2), blossom and water. Creatures included worms, insects, a frog, a snake, and a bat.</td>
</tr>
<tr>
<td>Kidnapped friend, track the bad guy &amp; Art from Nature</td>
<td>Not chosen</td>
<td></td>
</tr>
</tbody>
</table>
## Appendix

### 8.6.3. Kids Narratives St Andrews Part 2

<table>
<thead>
<tr>
<th></th>
<th>Child</th>
<th>Character</th>
<th>Personality</th>
<th>Friend/Adversary</th>
<th>Goal/motivations</th>
<th>Behavior/Weapons Features</th>
<th>Emotional Needs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Dalia</td>
<td>Rabbit/Deer</td>
<td>Friendly/Friendly</td>
<td>Fox/Evil elf</td>
<td>Get food home from fox, escape from hedgehogs</td>
<td>Eating carrots</td>
<td>Food and survival, Fear of foxes?</td>
</tr>
<tr>
<td>2</td>
<td>Jolyn</td>
<td>Deer</td>
<td>Shy</td>
<td>Rabbit/Fox/Elves</td>
<td>Eat bark to get bigger &amp; stronger</td>
<td>Elf has gun</td>
<td>Food and survival</td>
</tr>
<tr>
<td>3</td>
<td>Ellis</td>
<td>Banger the bat?</td>
<td>Cheeky</td>
<td>Foxy/Friendly/Family</td>
<td>Play hide and seek take over Cleo's kingdom</td>
<td>Flies through things</td>
<td>Be the best and in control of other animals, Overcome fear of bats?</td>
</tr>
<tr>
<td>4</td>
<td>Izzy</td>
<td>Two foxes/Toffee and Chocolate</td>
<td>Friendly</td>
<td>Vanilla candy and caramel</td>
<td>To get together, look after and feed babies</td>
<td>They are good but catch rabbits! Make parties</td>
<td>Romance, Nurturing the babies</td>
</tr>
<tr>
<td>5</td>
<td>Tatum</td>
<td>Leaf</td>
<td>Shy</td>
<td>Mum/Nettles</td>
<td>Not specified</td>
<td>Not specified</td>
<td>Protection by parent</td>
</tr>
<tr>
<td>6</td>
<td>Daisy</td>
<td>Fox</td>
<td>Friendly but sometimes shy</td>
<td>Badger/Elf/Badger and Foxy</td>
<td>Badger and Foxy make underground clubs</td>
<td>Guns from twigs, Squirrel says jump on branch to squash bat</td>
<td>Control power struggles, Hide in safety secrets, Collaborate with friends, Overcome fear of spiders?</td>
</tr>
<tr>
<td>7</td>
<td>Freddie</td>
<td>African Sand Spider</td>
<td>Family</td>
<td>Birds</td>
<td>Has been captured and escapes to find family again</td>
<td>Bites if threatened but usually only insects</td>
<td>BE with family, Escape, Win fights, Overcome fear of spiders?</td>
</tr>
<tr>
<td>8</td>
<td>Scarlett</td>
<td>Peanut Squirrel</td>
<td>Shy</td>
<td>Evil coconut</td>
<td>Find cousin, with the help of friends</td>
<td>Avoid the yeti! And get coins, Avoid the volcano and keep 20 lives.</td>
<td>Collect things, find family and friends</td>
</tr>
<tr>
<td>9</td>
<td>Tilly</td>
<td>Skateboarding snail</td>
<td>Protective people pretend to be normal</td>
<td>Mother and baby snail</td>
<td>Rescue people, Smash shell of evil snail and win fight</td>
<td>Wins fights, Super skateboard skills</td>
<td>Win, be stronger, have an impact, Overcome fears/dislike</td>
</tr>
<tr>
<td>10</td>
<td>Toby</td>
<td>Fox/Sensible</td>
<td>&amp; Snail/None</td>
<td>Enjoys a fantasy world of nature when he becomes a fox</td>
<td>Enters a fantasy world of nature when he becomes a fox</td>
<td>Gets super small to be part of nature, Magic potion.</td>
<td>Escape and fantasy through 'magic'. Explore the world.</td>
</tr>
</tbody>
</table>
| 11 | Hedgy | Rabbit and Snail | Benjimon | None | Looking for magic diamond, Take over world, Benjimon king of bugs | Special scarf | }
<table>
<thead>
<tr>
<th></th>
<th>Character</th>
<th>Characteristics</th>
<th>Abilities</th>
<th>Threats to Home</th>
<th>Actions</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>Hopsy Rabbit Bird</td>
<td>Friendly but can be shy about speaking out</td>
<td>Cheesy mouse, Cocky the Cockroach, Always doing important missions</td>
<td>Secret codes to get into their house, Hopsy has jumping superpower, Bird has special blinding feathers</td>
<td>Have impact in the world: Control Overcome fear of bugs</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Ginger the fox (does not eat rabbits)</td>
<td>Fluffy fox (eats rabbits)</td>
<td>Evil Mousey</td>
<td>To stop threat to their home which is under attack</td>
<td>Ginger can run super fast</td>
<td>Protect what is theirs</td>
</tr>
<tr>
<td>14</td>
<td>Afro Tree</td>
<td>Afro tree looks after their home</td>
<td>To stop the tree fellers</td>
<td>Grows with water and dirt (magic potion) and can hit with branches</td>
<td>Protect self and others (win?) Fantasy ’magic’</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Bad Bird</td>
<td>Generally unreadable</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Chloe Rabbit</td>
<td>Friendly and always playing</td>
<td>Ginger the Fox, Buggie the bug</td>
<td>Magically make buggie the bug nice</td>
<td>Chloe is a princess who loves carrots</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bad Ratty</td>
<td>Brave but not very strong Fast</td>
<td></td>
<td>He likes to be different, do athletics and eats a lot</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Introduction

In this session we are going to turn your stories into a game format. It will be just one level of a game.

You are going to create some videos using Morfo to make characters to introduce your mission and give clues.

1. Activity 1:
Your games ideas inspired, a range of stories you will be given one to work on.

1. Your animal friend has had their house destroyed by evil snake and they just escaped in time. What natural objects could you use to create a new home for them that will protect them?

2. A wizard needs to make a magic potion to cure your animal friend.
What natural objects would they need to find to make into a potion?

3. A baddie is trying to take over the forest and you need to get superpowers in order to defeat them?
What natural objects could you eat and what superpower do they give you?

4. Your friend has been kidnapped by an evil weasel and you need to track them and find signs in the wood to follow them.
What signs e.g. certain flattened bushes, mole hills, tracks, poo (!) etc. would you look for to follow them?
2. Activity 2: Choose a natural character, Animate them in Morfo to tell the player what to do for your game level.

3. Questions:

If there were a series of missions like this, how would you like to be rewarded in the game?

Tick one or describe your own...

1. Collect a character to be your friend in the game or for another online game?

2. Collect points or coins so that you get a score to compare with others?

3. Have a ‘power up’ of your character so that it gets different qualities and can compete with other players in an online game.
### 8.6.5 University of Brighton: Location Based Game

**Your Names:**

You can probably guess what animal this is from the illustrations. Write your answer here_______________________

This character appears in your game design for today. Choose one image that you prefer to appear in the location based game as this creature and use it to record the script you have written as an animation in Morfo.

Say why you chose it?

_______________________________________________________________________

---

<table>
<thead>
<tr>
<th><img src="#" alt="Image 1" /></th>
<th><img src="#" alt="Image 2" /></th>
<th><img src="#" alt="Image 3" /></th>
<th><img src="#" alt="Image 4" /></th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="#" alt="Image 5" /></td>
<td><img src="#" alt="Image 6" /></td>
<td><img src="#" alt="Image 7" /></td>
<td><img src="#" alt="Image 8" /></td>
</tr>
</tbody>
</table>
Appendix

8.6.5 University of Brighton: Location Based Game
Appendix

8.6.5 University of Brighton: Location Based Game
8.6.7 Stories for co-design activity phase 3.

<table>
<thead>
<tr>
<th>Main character</th>
<th>Treasure Hunt ludic game mechanic</th>
<th>Adventure (story based) game narrative.</th>
</tr>
</thead>
<tbody>
<tr>
<td>An evil tree needs gold (that the player collects)</td>
<td>Each time the player gets gold, the tree will free one of their animal friends it has captured.</td>
<td></td>
</tr>
</tbody>
</table>

Notes: this group were able to add quite specific instructions about what to look for next through their characters, in part 2.

<table>
<thead>
<tr>
<th>An evil wizard has captured animals inside of the trees and to release them the player has to visit locations and do tasks.</th>
<th>They collect ingredients for a magic potion to overcome the wizard and save their friends.</th>
</tr>
</thead>
<tbody>
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<td>They collect ingredients for a magic potion to overcome the wizard and save their friends.</td>
</tr>
</tbody>
</table>

Notes: Some of the activities and information presented in the AB game testing were recreated in their own game version, e.g. recognizing elderflowers, the group also added observing insects inside flowers and photographing them.

<table>
<thead>
<tr>
<th>The weasel and the shape shifter take over the forest.</th>
<th>The group created a ‘spy’ theme. A shape shifter character was added to assist the weasel in their plot, also involved survival methods, such as den building.</th>
</tr>
</thead>
<tbody>
<tr>
<td>The weasel and the shape shifter take over the forest.</td>
<td>The group created a ‘spy’ theme. A shape shifter character was added to assist the weasel in their plot, also involved survival methods, such as den building.</td>
</tr>
</tbody>
</table>

Notes: One activity included ivy around a tree and asked players to note how it was in the plot to strangle the forest in the take-over.

<table>
<thead>
<tr>
<th>An evil bat plans to take over the forest, find materials to make weapons to defeat it.</th>
<th>Defeating the bat involves picking up weapons, examples shown below.</th>
</tr>
</thead>
<tbody>
<tr>
<td>An evil bat plans to take over the forest, find materials to make weapons to defeat it.</td>
<td>Defeating the bat involves picking up weapons, examples shown below.</td>
</tr>
</tbody>
</table>
### 8.8.8 Photography Phase 3

#### Children’s Photographs of Locations

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a)</td>
<td>Pictures of bugs were featured widely as before with the previous group. Every group took at least one picture.</td>
</tr>
<tr>
<td>b)</td>
<td>One group featured insects inside buttercups. Looking for them was later turned into an PBMG activity. There were also ten different flower pictures of different species.</td>
</tr>
<tr>
<td>c)</td>
<td>Signs of animal activity were featured, with photographs of holes they lived in and mole hills repeated for this session.</td>
</tr>
<tr>
<td>d)</td>
<td>Nettles and their antidote the Dock leaf were photographed again this time and discussed by two of the groups. The children in one group talked about this as if it was ‘magical’.</td>
</tr>
<tr>
<td>e)</td>
<td>The same root system photographed in the previous year workshop also feature in one of this year’s groups. It was described as ‘scary’.</td>
</tr>
<tr>
<td>f)</td>
<td>One of the children took this picture and asked if it was ‘elderflower’ that had featured in the game they played. It was, in fact, a poisonous flower.</td>
</tr>
<tr>
<td>Appendix</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>g)</td>
<td>This shot of ‘king alfred's cakes’ was taken by one of the children. The other children in the group showed fascination when the guide told them the name and narrative behind it.</td>
</tr>
<tr>
<td>h)</td>
<td>Three different shots were taken of smaller trees and they were described as ‘baby trees’.</td>
</tr>
<tr>
<td>i)</td>
<td>Once again several children took images of new growth or ‘seed like’ signs of reproduction.</td>
</tr>
<tr>
<td>j)</td>
<td>Areas of contrasting colour were taken by two of the groups and one group contrasting light as in this picture.</td>
</tr>
</tbody>
</table>