GameFlow experience model: understanding player enjoyment in pervasive adventure geocaching game

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Abstract: Game developers have identified, explored, and discussed many of the key issues that arise for players interacting in game worlds and the physical world. This study presents the GameFlow experience model, which is empirically tested by six case studies, with the focus on the interplay between player enjoyment and social context. Geocaching is technology-supported treasure hunt activity that uses a Global Positioning System (GPS) receiver or a smartphone with a geocaching application to find something hidden by other players (Geocaching.com). The results provide a deeper understanding of enjoyment in real-time gaming played in the physical world and other users could follow your experiences virtually, along with the identification of the strengths and weaknesses of the GameFlow experience model as an evaluation tool. This study concluded that the GameFlow experience model could be used in its current form to evaluate pervasive adventure games. This study presents design guidelines for designing and evaluating enjoyment in adventure games.

Keywords: user experience; GameFlow experience model; geocaching game; mobile computing; ubiquitous computing.


Biographical notes: Pirita Ihamäki received an MA degree in Digital Culture from the University of Turku, Degree Programme Cultural Production and Landscape Studies in 2001 and an MSc (Economy) degree in marketing from Turku School of Economics in 2011. She is currently working in Rock My Business Ltd. as a Concept Designer. From 2008 to 2010, she was a researcher in the Tampere University of Technology Unit of human-centred technology. She is the author of two books and more than 20 papers, and she has presented papers in more than 30 conferences. Her research interests include digital culture, digital education applications, digital tourism applications, and user-centred design.

1 Introduction

In game design, the driving force is the user’s experience. Game designers try to imagine what players will experience as they work their way through the game, trying to deliver the most exciting and compelling experience possible (Swartout and Lent, 2003), for example, in the recently released pervasive game geocaching, which builds popularity with adventure-seekers. Geocaching is an interactive treasure hunt game in which participants use Global Positioning Systems (GPS) to seek out a cache or a container, which has been hidden at a specific coordinate (Geocaching.com).

Understanding what makes players enjoy a game is perhaps the most important issue in successful digital game design. From a research perspective, an understanding of player enjoyment enriches the evaluation of the experimental pervasive adventure game, the geocaching applications in several case studies. A pervasive game is a game that has one or more salient features that expand contractual magic circle of play spatially, temporally or socially (Montola et al., 2009, pp.12.) Digital games are not only games, they have also become more involved in everyday situations and pervasive games are more exploration trips in the world with a GPS device or smartphones. This study presents the GameFlow experience model which extends the scope of the experience game design field. Based on many case analyses, this study provides the core elements underlying the phenomena that constitute experience with treasure hunt applications. A comprehensive review of the literature on usability and user’s experience in games was conducted to determine how the elements of flow manifest in computer games. This GameFlow experience model in digital games was constructed
from the literature based on the elements of flow, and the evidence of empirical findings extended the flow experiences in games. It is important to evaluate players’ experience in popular games like geocaching, in which designers and researchers could learn important aspect to design new games or use games in totally different contexts such as in tourism and education. There is not a large body of academic research on the geocaching game worldwide. The main research question in the study is: how should a digital geocaching application be developed to promote pleasurable experiences? And a secondary question is how do participants experience pleasure in playing geocaching?

This paper is organised as follows. In the first section, the goals of study and research questions are described. Section 2 consists of a literature review of related work. Section 3 presents the methodology of this study. Section 4 describes result of the theoretical background and empirical evaluation through the GameFlow experience model, and finally presents design guidelines. Section 5 draws conclusions and indicates future work.

2 Method

2.1 Experiential design

Whether developing the geocaching game solely for entertainment, or with ulterior motives such as social experience or emotion experience and feedback, designing an enjoyable experience remains one of the most important aspects. In the evolving area of geocaching game development, a relatively new genre known as ‘Pervasive Gaming’ has recently emerged. Pervasive games aim to blur the lines between the virtual world of the game and real world of the player in order to bring a more immersive and entertaining game experience (Macvean and Riedl, 2011).

Over the last decade, researchers have seen a substantial growth in the research of user’s experience and ways of understanding and designing for user experiences (Buchanan and Fulton, 2000; Forlizzi and Battarbee, 2004; Hallnäs and Redström, 2002; McCarthy and Wright, 2004). The goal is to go beyond supporting user’s activities geocaching game in an effective and efficient manner, and to focus on their pleasure, fulfillment and sense of well-being. By user experience (geocachers), we mean getting insights into users’ activities that are not directly related to solving design problems but are used to support and improve the creative nature of design. In this study, we try to understand design practices and build technology to support these practices which we need to identify these experiential processes that designers apply.

This case study increased the understanding how users develop geocaching game, how they communicate with others’ tool methods, and approaches that they use for designing and so on. These cases have taken an ethnomethodological approach (Garfinkel, 1967) to understand their design practices and in particular what role communication tools play in this. The reason to take this kind of approach is to understand how users’ develop geocaching game in their everyday life settings as they happen, without attaching any preconceived measures. The overall goal of the research is to develop collaborative GameFlow experience model for game designers, HCI researchers and adventure service practitioners.

The ethnomethodologically informed approach helps in understanding the detailed and observable practices and methods of users, which can reveal mundane and everyday social facts. The five case studies were published between 2012 and 2014, but data material was collected between 2006 and 2013. This study uses methods such as naturalistic observation, also virtual Groundspeak forum bulletin board communication, interviews and contextual interviews, the Self-Assessment Manikin (SAM). The data from our cases studies were qualitatively analyzed. Geocaching game emerged as describing different experiential practices of users and the role of communications tools played in those practices. To make results clearer and more comprehensible, it is presented in two stages: first, this study goes through the stages of the evaluation process where geocaching plays an experiential role (Section 3) and in the second part it will go into details to describe ‘how’ GameFlow model stages help to develop pervasive adventure game concepts (Section 4).

2.2 Experiential role of geocaching

During fieldwork findings, it was found that it is important to understand the experiential nature of geocaching in three levels of evaluation: exploration, communication and use (Figure 1). Exploration level refers to an early stage of design where researchers use different methods to understand the problem and the situation that they are designing for. Communication level refers to the phase where users and researchers collaboratively develop ideas and concepts using different methods and techniques. Use level refers to the phase where users and researchers try to evaluate and test their ideas and concepts amongst themselves and with prospective users (Vyas, 2009). There are blurred boundaries between these evaluation phases and it is only in order to associate different methods and data with these phases (see Figure 1) that we apply this classification to evaluate the five case studies of geocaching game concepts and extended secondary material (geocaching articles) to create the GameFlow experience model.
As shown in Table 1, there is a list of case study methods associated with the three phases of evaluation. There are mainly two types of evaluation phases: those that are already in the geocaching environment and those that are created by researchers and users in and around geocaching game. Both will be taken into account in the analysis.

2.2.1 Exploration

From the fieldwork (five case studies), this study observed that designers and researchers take into account methods of user’s experience and life cycle of how to create new pleasure experiences of pervasive adventure concepts. These phases are already in the geocaching community and the way they are organised, arranged and maintained informs how these are experienced by users. In some cases, user-generated data produced during different design exploration methods, such as the self-report method, were used for collecting user’s experiences in the first case study in real environment and also to inform designers and researchers about students’ experiences. These evaluation processes represent user’s expressions and reasoning of their everyday life. In the exploration phase, to a certain extent, users and researchers try to develop a sense of empathy with users’ experiences geocaching concepts. These evaluation phases may not be seen as isolated objects indicating aspects of users’ experiences but these are evidences of the events that are related to social and collaboration circumstances.

2.2.2 Communication

This phase observed how case study data and users’ communication channels in geocaching game, that are created by users and researchers as design representations, such as storyboards, scenarios, physical services and so on, help in communicating the experiential information common-ground in case studies. These evaluation phases go through case studies to evaluate experiential geocaching game and pervasive adventure concepts. Importantly, case studies such as build GameFlow experience model allow the researchers and designers direct and bodily engagement and hence broaden communicative resources by evoking sensory experiences. The multi-modality and ability to support and convey information through all senses make the use of case studies experientially rich (Iacucci and Wagner, 2003). In the geocaching of joint design activities, co-creators do not just interact with these case studies when they are designing, they actually get the enjoyment and experience of each
Table 1  Three levels of evaluation process where case study method and data play an experiential role

<table>
<thead>
<tr>
<th>Exploration</th>
<th>Communication</th>
<th>Use</th>
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<tr>
<td>FIRST CASE STUDY METHODS: The (SAM) self-assessment manikin measuring generalised emotional states. Self-report methods were used for collecting user experience information in real environment field experiments. Expressing emotions and experiences (3E) idea is the emotional expressions that could use as social language, which the user can use in communicating with the researcher. The 3E method provides the user a structured way of expressing emotions by drawing and writing.</td>
<td>FIRST CASE STUDY DATA: The result indicated questionnaire using the SAM method and exercises using the 3E method, which can provide detailed and versatile material about children experiences and emotions, related to them. Material consists of 110 students’ questionnaire answers and exercised, which allow children to express their emotions with a combination of picture and an explanatory text.</td>
<td>FIRST CASE STUDY: Ihmäki (2014a) The Creative potential of treasure hunt games to enhance positive emotions during experiences relating to local geography and history.</td>
</tr>
<tr>
<td>SECOND CASE STUDY METHODS: The problem-centred interview (PZI) is a theory-generating method, which suite focus group sessions in class room, that tries to neutralise the alleged contradiction between being directed by theory or being open-minded so that the interplay of inductive and deductive thinking contributes to increasing the user’s knowledge. The collaborative learning exercises strategies aim, firstly, at the representation of the subjective approach to the problem; secondly the stimulated narratives are enriched by dialogues employing imaginative and semi-structured prompts. It helps students crystallise and articulate their experiences.</td>
<td>SECOND CASE STUDY DATA: The data consist of survey data and Facebook materials in course called “Pori stories based on the game of Geocaching” in University of Turku, Cultural Production and Landscape Studies. Material also consists of narrative stories for geocaching place, pictures, video material, which have made in geocaching course in university.</td>
<td>SECOND CASE STUDY: Ihmäki (2014b) design “The Pori hidden beauties geocaching series”: Computer-supported collaborative learning and sharing experiences.</td>
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<td>THIRD CASE STUDY METHODS: This case study has gathered for internet survey for Geocachers and is based on 52 responses.</td>
<td>THIRD CASE STUDY DATA: Material contains for internet survey 52 responses. Secondary material is based on geocaching stories in magazines all over the world, linked to Geocaching.com, that are used here to expand the description of creative tourism products and how geocaching is used in tourism or to design new applications around the game.</td>
<td>THIRD CASE STUDY: Ihmäki (2012a) geocachers the creative tourism experience.</td>
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<td>FOURTH CASE STUDY METHODS: Therefore, a classic descriptive case study is not solely narrating the case or general descriptive writing that has no connections to theoretical reasoning. The goals of the description can also be to depict observed or innovative use in everyday situations. This case study depicts geocaching as collecting travel experiences and aspires to understand geocaches situated along Coastal Road in Finland.</td>
<td>FOURTH CASE STUDY DATA: Material contains for internet survey 23 responses in 2004 and a second round of semi-structured email interviews was conducted with three selected geocachers, who has placed geocaches on Coastal Road in 2008.</td>
<td>FOURTH CASE STUDY: Ihmäki (2013) geocachers’ creative experiences along coastal road in Finland.</td>
</tr>
<tr>
<td>FIFTH CASE STUDY METHODS: This case study has gathered for preliminary survey. After filling out the preliminary survey, users underwent the main test of finding three geocaches around Ylivieska Centria campus area. After the user test, participants filled out an evaluation.</td>
<td>FIFTH CASE STUDY DATA: Material contains for user test 17 participants (eight female and nine male), all of whom knew how to use mobile phone and map applications. Since a regular session of the geocaching game usually takes up to one and a half hours, we decided to test users in a predefined mid-game position. This position gave some advantages to the users and was designed with the intention of walking with users (normally with three-user groups) and seeking three different geocaches in Ylivieska, Finland.</td>
<td>FIFTH CASE STUDY: Ihmäki and Luimula (2013) understanding the enjoyment with geocaching application.</td>
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</table>
other’s activities through these evaluation phases. This really helps in process of collaborative design in which the designers and users are always in search of new, creative and inspirational ideas. The communication channels that are established by the multiplayer geocaching game go beyond facilitating and satisfying basic task-oriented activities. To an extent, as we observed, the whole case studies method and data design practice progress through the use and iterative refinements of both the conceptual and physical designs of concepts being designed.

2.2.3 Use

This is the phase where users, researchers and designers try to develop a better understanding of what it is really like to use the geocaching game concepts and pervasive adventure concepts that they have collaboratively designed. Users design geocaching game in year 2000 and continue the game development and add communication channels around the game and test their system themselves and use the system in their natural environment. The goal is to convey a specific type of experience through using geocaching game in new contexts such as education and tourism in these case studies.

In this fieldwork, we have analysed the case studies through the GameFlow model. However, the experience of the geocaching in the current situation also adds to the overall quality of use. Final geocaching concepts or services evolve during an iterative process where users, designers and researchers experiment first with low-fidelity artefacts (e.g. local geocachers) and later with functional prototypes to collect feedback on the user experience.

3 Result: experiential case studies through GameFlow experience model

The analysis of the ethnographic data leads to a rich set of experiential practices that researchers apply in their design using geocaching game or treasure hunt games in new concepts. This will go through the evaluation process and present the results as GameFlow experience model of experiential practices utilised by researchers and designers as we explored these from the fieldwork. This case study discusses how empirical data play a role in supporting the GameFlow experience model. I believe that these practices are not specific to the geocaching game only, which can be seen very common in other pervasive adventure concepts as well.

Since experience is an interaction-centred framework, the contextual issues are not neglected here. When designers try to envision a certain form of experience – for instance, the emotional form – they actually have to consider the context of users’ interaction, which may include their relationship with others (social experience), the physical environmental setting (challenges experience) like traffic, and immersion experiences like intensively seeking treasure in woods (Vyas and van der Veer, 2006). These contextual issues will become clearer in the next sections. The GameFlow experience model is presented in Figure 1.

This GameFlow experience model in digital games was constructed from the literature based on the elements of flow, and the evidence of empirical findings extended the flow experiences in games. The result is the GameFlow experience model, which consists of eight core elements: (a) user and player experiences and challenges, (b) social experience and co-experience, (c) player creative experience, (d) emotion experience and feedback, (e) temporal experience and control in game, (f) educational experience, (g) flow experience, and (h) narrative experience and clear goals.

The GameFlow experience model uses geocaching game in contexts of education and tourism. Context of use has elements of physical context, social context, temporal context and technology context. Physical context describes the features of situation in which the human–mobile computer interaction takes place, including spatial location, functional place, sensed environmental attributes, movements and mobility and artefacts present (Roto, 2006; Jumisko-Pyykkö and Vainio, 2010). Geocaching has playground in real environment, where geocaches take place. Geocacher gets location-based experiences with different geocache places and see the places through their own eyes. However, physical context also includes internet environments, where users could choose for their geocaching trips and conversation their experiences with others. The task context describes the specific interaction with mobile multitasking and related task (Roto, 2006). Geocaching has task context, for example solving problems before to find geocaches. Social context describes the situation of the user to be present, their roles, and the interaction between communities (Belk, 1975). Geocacher creates different social platforms like Geocaching.com, GroundSpeak Forum bulletin board, Facebook local geocachers channels; Geocachers always create unique geocaching events, all of these create social context in geocaching game. Temporal context describes factors of past and future situations, from time of day to the week, month or season (Belk, 1975, Bradley and Dunlop, 2005). Geocaching is situated in temporal context, because players can play for an hour, or even days, but players can also be out of the game for long time or in holidays. Technical context focuses on devices, available infrastructure, facts and system assumptions (Petrelli et al., 2001), sensors (Fogarty et al., 2004) and network services (Winograd, 2001). Geocaching game based on using coordinates, and users use mobile phones and several applications to play geocaching game. Geocachers are also active technological enthusiasts and they always develop the some new technological software around the game.

3.1 Player’s experience and challenges

In the study, the main purpose of a player’s experience is to understand what aspects constitute the enjoyment of playing the game, what kinds of experiences the game can elicit, and how to design something that elicits a certain type of experience (Korhonen et al., 2009). Here, enjoyment is
considered the core experience of entertainment (Vorderer et al., 2004), defining the sum of positive reactions towards geocaching experiences as being both cognitive and affective. The first case study, which explores the application of treasure hunt games to local geography and history, is descriptive account of 110 students’ interaction with using letterboxing and geocaching as method, through the solve clues and exercises children’s findings in the road. Student feels that, “I get different picture of town and places of Pori” (student of 4th class); “Moving on treasure hunt road was nice and I could learn also history of Pori” (student of 4th class). Student seems to like quite much whole treasure hunt road.

Digital games are a prevalent form of entertainment in which the purpose of the design is to engage players. Game designers incorporate a number of strategies and tactics for engaging players in ‘gameplay’. Game design is at the forefront of cultivating innovative techniques for interactive design (Dickey, 2005). For adventure games to be enjoyable, they must support player skill development. In order for the player to experience flow, their perceived skills must match the challenge provided by the game, and both challenge and skills must exceed a certain threshold. Therefore, it is necessary that players develop their skills at playing to truly enjoy the game (Sweetser and Wyeth, 2005). In the second case study, student Piritta Huhtala got a ‘wau experience’ in the course because she found her first geocache. “I have always been really bad to navigate, but when you have technical equipment to help, such a lousy navigator could find the geocache” (Ihamäki, 2014b).

Games should be challenging, match the player’s skill level, vary the level of difficulty, and keep an appropriate pace. An important precursor of flow is a match between the person’s skills and the challenges associated with an activity, both skills and challenges being over a certain level (Johnson and Wiles, 2003). Third case study has presented extreme geocaches, that is one of the geocache types and those cache users need special equipment and special skill to reach on caches. Extreme geocaches offer contrast to ordinary caches, especially in physical and mental challenges. Geocacher Rajze describe that extreme cache is “the most challenging cache, I ever attempted and even heard of (except that I.S.S. one and the one 2300 meters under sea levely)”: “If you don’t know what it takes to reach the cache and you’re not well prepared for this action, it’s really dangerous and could be fatal for you. So if you think you can beat it, I wish you best of luck, it certainly isn’t easy. A true extreme cache!” (Rajze and K2 Team, Geocaching.com, 2011; Ihamäki, 2012a).

Player experience in the geocaching game could look at the point of when people interact with each other; the geocaching game has many levels of interaction. The geocaching game has spread into many areas in the mixed reality games field, and a player interaction level depends on the player’s challenges and enjoyments. For case study, Yomyohan (Geocaching.com, 2008) describes geocache sites “broaden your view of the world, add to your knowledge of local area; of its history and sights. Bring adventure into your life”.

3.2 Social experience and co-experience

Digital games offer opportunities for social interaction (Tychsen et al., 2006; de Kort et al., 2007). In fact, according to gamers, socialising is the topmost motivation for playing digital games (Tychsen et al., 2006). Games should support and create opportunities for social interaction. Social interaction is clearly a strong element of enjoyment in games, as people play games for social interaction, whether or not they like games that they are playing (Lazzaro, 2004). Third case study is described by example ‘Iron Wheels of the Helsinki City Transport’ geocaching event via the Geocaching.com webpage calendar. The ‘location’ of the event was a rented tram moving around in the city of Helsinki. Participant moved around the city to find new geocaches published in the early morning of the event day. The event was unique in that it offered new, different and surprising elements; while the geocachers were moving for two hours from one cache to another place (Ihamäki, 2012a). “This happening was once in a lifetime case”, said by geocacher Sikajack (Geocaching.com, 2007). “It is rare to have your ‘own tram’, and so when the opportunity occurred, of course I wanted in!” said by geocacher Kuukkelit (Geocaching.com, 2007). “The event was once in a life time experience, not many people can say that they spent few hours in a tram going around Helsinki on independence day with more than hundred like-minded people. This is a nice experience to remember in retired” (Ihamäki, 2012b).

Playing can be with real and present friends, digital game agents, or mediated human co-players (i.e. online play). To date, little attention has been given to the nature and role of the exact social setting in explanations of player enjoyment. In spite of the clear social roles digital games play, the social component of gaming is often missing in theories and models of player experience; and digital gaming platforms are not valued to their full extent as a medium that brings people together (Ermi and Mäyrä, 2005; Sweetser and Wyeth, 2005). In the fifth case study, social experience and co-experience element of concentration should support and create opportunities in the game. “Geocaching makes possible a competitive game among a group of friends”. To support concentration certain gameplay element, games should create opportunities for player competition, cooperation and connection (Pagulayan et al., 2003). Sweetser and Wyeth’s (2005) GameFlow element of feedback means that players must receive appropriate feedback at appropriate times. “It shows directions so a group of friends can navigate easily. It provides helpful information on where we can find geocaches; with friends we could also discuss various opinions”.

The term ‘co-experience’ is used to describe how experience with geocacher creates new types of geocaches in terms of the meaning of individual experience emerges and changes as it become part of social interaction and social capital. The first case study interaction with using letterboxing and geocaching as method, through the solve clues and exercises children’s findings in the road. “Almost every exercise was nice. Nicest thing was that all cooperated together” (student of 4th class).
3.3 Players’ creative experience

Another theme that arose was player creative expression, which is the freedom that a player has in expressing their creativity and intentions by playing the game in the way they want, rather than the way that the designer had intended it to be played (Sweetser and Johnson, 2004). Third case study presents the ‘Seaway Trail’s new Geo Trail ‘Caching’ opened in August 2010, for travellers. The Geo Trail encourages participants to get outside and experience the scenic, natural, historic, and cultural resources of the Great Lakes Seaway Trail National Scenic Byway. The 518 mile byway is divided into five regions with approximately 15 caches located within each region. Geocachers finding at least ten official Geo Trail caches in one region can redeem their passport for a free commemorative Geo Trail Coin for the region. GeoCacher’s creative tourism means that they voluntarily make short or long trip along Geo Trail Coast and they could collect geocoins or not. Geocacher’s chances experiences by logbooks in geocaches for Geo Trail and in internet geocaches own web pages (Ihamäki, 2012a). Creative experience could be understood as something active that involves users in self-development. In creative experience, the responsibility is on the users themselves to actively learn about their surroundings and apply that knowledge in order to develop their own skills (Richards and Wilson, 2006). In the first case study, students solve clues to find geocaches and there has always exercises in the geocache. One treasure hunt place was a churchyard, and students felt very interesting to stand of front of church, because the exercise was to draw and describe the church and give hints for Sofia and Vilhelm that they will find for place. “When we were yard of church and we need to draw or describe for that, it was exciting” (student of 4th class).

The geocaching as a hobby poses quite challenge for a multitude of reasons including use of navigational equipment and users’ creativity in making hints. The Groundspeak forum (bulletin board) offers many opportunities to participate in every sense of the creative experience. The growth of geocaching in the past 14 years is astonishing. There have been a number of innovators that have come and gone, from websites providing listing and maps to newsgroups and newsletters. As technology grows and changes the geocaching momentum continues to build. Geocaching is a variant of the pervasive game, because users have to create the body of the game concept. Users make geocaches in the world; there are now more than 6 million caches in the world. One of the user goals is to create new kinds of cache ideas. The participants of fifth case study create new ideas, challenging the geocaching game, for example “people can change the position of a target just for fun to mislead other players; the interface could be changed, for example, another picture of the compass can be inserted”. Players should feel a sense of control over the game interface and game controls, with mastery of the control system being an important part of most games (Johnsson and Wiles, 2003).

3.4 Emotion experience and feedback

Emotion experience is defined as a complex construct with physiological, affective and cognitive dimensions, and is the core of entertainment media (Vorderer et al., 2004). Players are not simply directing their attention but are physically or mentally becoming part of the gaming experience itself through active participation. The geocaching game can be classified as escapist experiences where active participation and immersion play a central role. In the first case study, children describe their experiences like “I remember last treasure hunt place because in University of Turku library we have to find number of one book and behind of book we find eyeglass enclosure the last treasure” (student of 4th class). The students like idea to experienced road through the historical story, where they have exercises (Ihamäki, 2014a).

Csikszentmihaly (1990) introduced the concept of flow, which has since become fundamental to the fields of positive psychology, happiness, creativity, subjective well-being, and fun. Flow represents the feelings of complete and energised focus in an activity, with a high level of enjoyment and fulfilment. According to the flow theory, positive experience becomes an important reason for performing an activity; if an activity is interesting, it is motivating and people are more likely to engage in the activity for its own sake. Participants of fifth case study become immersed in searching for the geocaches “Time flew by while I was collecting geocaches and information”.

The emotional form bears the subjective evaluation of the situation in game. It is related to different emotions (e.g. joy, anger, disappointment, disgust) elicited during interacting with the game system (Vyas and van der Veer, 2006). During the player-centred design stages, questions arise, such as how can we design the interaction mechanisms for the games that could lead to an emotional form of an experience? In the fifth case study, the GeoCentria application motivates the use of geocaching too, for example, “make a recreational day”. The geocaching game was enjoyable for participants: “I like to go search for geocaches, and explore new areas”.

Players received appropriate feedback at appropriate times. During flow, concentration is possible because the task provides immediate feedback (Csikszentmihaly, 1990). Players should get feedback on their progress, and games should provide immediate feedback for players’ actions (Desurvire et al., 2004; Johnson and Wiles, 2003) and games should reward players with feedback on progress and success (Lazzaro, 2004).

One of the levels of interaction in the geocaching game is to announce your find to Geocaching.com, on the cache’s page, to gain your points. For each cache found, the player gets a point. This makes geocaching a game. Players can also write a log detailing their experience on the website. This allows future cache seekers to see when it was found and possibly to learn from your experience. Most geocachers provide feedback on the caches they find; some have even come up with a more elaborate way to rate them.
### 3.5 Temporal experience and control in game

The experience flow is temporal, starting with first-time use, and its eventual success depends on its continual long-term use. According to Csikszentmihalyi (1990), enjoyment, as realised in the flow state, is an autotelic or self-motivating experience characterised by the following:

- Intense and focused concentration on what one is doing in the present moment,
- Merging of action and awareness,
- Loss of reflective self-consciousness (i.e. loss of awareness of oneself as a social actor),
- A sense that one can control one’s actions; that is, a sense that one can, in principle, deal with the situation because one knows how to respond to whatever happens next,
- Distortion of temporal experience (typically, a sense that time has passed faster than normal), and
- Experience of the activity as intrinsically rewarding, such that often the end goal is just an excuse for the process (Nakamura and Csikszentmihalyi, 2002, p.90).

**Figure 2** Flow, anxiety, and boredom as functions of medium, difficulty and skill (see online version for colours)

Activities that are most likely to create the flow state are those that (a) have concrete goals with manageable rules, (b) make it possible to adjust opportunities for action to our capabilities, (c) provide clear information on how we are doing, and (d) screen out distraction and make concentration possible (Csikszentmihalyi, 1990).

Third case study, experience of the activity as intrinsically rewarding, such that often the end goal is just an excuse for the process (Nakamura and Csikszentmihalyi, 2002, p.90).

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### 3.6 Educational experience

This study covers educational experience; as a person matures, she/he accumulates a growing reservoir of experience that becomes an increasing resource for learning (Baird and Fisher, 2005). The first case study, exploring the application on Treasure Hunt games to local geography and history by letterboxing and geocaching, was pilot case and meaningful for educational tool. The treasure hunt road gives children educational experience, “I have learn history of Pori” (student of 2nd class) “Nice road and I could go for second round” (student of 2nd class) (Ihamäki, 2013a), places of awareness, in a broad sense, describe the geographical as well as ‘social spaces’ where interactions take place, including the hotspots of interaction. This can be seen as a multi-layered concept: personal versus private spaces of members within a geocaching community or a building, and whole (geocaches) experience in different environments like under the bridge. Observations call into question categories of awareness: ‘how does the spatial layout influence the structure of interaction?’ (Vyas et al., 2007). Third case study describes that GPS Adventures Maze is a travelling educational exhibit developed to teach people of all ages about navigation, GPS technology and geocaching. As hands on experience that features GPS technology (its history, current uses and future possibilities), it simulates geocaching by leading visitors through a 2500 square foot maze rich with interactive educational experiences (Ihamäki, 2012a). The educational experience could understand, as motivation to learn is internal, that protecting one’s self-concept and/or self-esteem is a strong motivator to acquire new information (Baird and Fisher, 2005). The motivation to learn an experience is internal – for example, in the case of extreme geocaching experiences that users want to share with other geocaching community members. Users are motivated to learn with others’ experiences; for example, geocachers who are interested extreme geocaching want to share exciting and difficult to reach geocaching places with others. The motivation to learn and experience has grown with increased possibilities to co-experience things and learn new things with others, for example in YouTube. The motivation to learn an experience has the consequence of creating new information, which extends social capital and values of communities.

Geocaching was adopted by Sterling and Francine Clark Art Institute, where they celebrated Earth Day, 22 of April 2009, by kicking off a new GPS program and celebrating the Clark’s Art in Nature geocache (http://media-newswire.com/printer_friendly_1089286.html). Third case study geocachers describe how to learn with other geocachers “(...) part of caches are technically brilliant, part caches are extreme beautiful places, part of caches are so big pain to find, that in the end caches to remembering for respectful way and warms. In addition afterwards I follow the other player’s how they reach those cache places” (Geocachers Tellit). Educational experience has opportunity to expand experiences in quite many areas in geocaching game and other pervasive adventure concepts. Geocaching game has an idea to create something new in around game and at the same time share educational experience with others.
3.7 Flow experience

Today’s mainstream entertainment revolves around interactivity. Specifically, players want full immersion entertainment experiences in intelligent environments (Cheok et al. 2006). During the optimal flow experience, a student is in a psychological state where he or she is so involved with the goal-driven activity that nothing else seems to matter. An activity that produces such experiences is so pleasant that the student may be willing to do something for its own sake, without being concerned with what he or she will get out of his or her action. The subjective experiences of players as they play games are at the heart of explanations of engagement in games and a range of construct: flow (Csikszentmihalyi, 1990), immersion (Jennett et al., 2008), presence (Wirth et al., 2007) and arousal, which have overlapping but also distinctive characteristics. These constructs have been proposed to explain the often positive experiences that game-players have, presenting a huge challenge for learning game designers in terms of translating the benefits of entertainment games into educational game contexts: how can we create games that pleasant as many players as possible and are still educationally effective? (Kiili et al., 2012). First case study students’ one exercise is to seeking on codes in the road, which they get hints from the teachers. Sometimes students get so flow experiences to seeking hints that they forget the listen the teachers to give them a hints. Teachers have their own challenges to make student engagement on treasure hunt road, like some “student are so interesting to seeking on treasure that that they don’t listen well when I give them exercise” (Ihamäki, 2013a). Players should experience deep but effortless involvement in a game. Immersion, engagement, and absorption are concepts that are frequently discussed and highly important in game design and research. The element of flow that described immersion is deep but effortless involvement, which can after result in loss of concern for self- and everyday life, and an altered sense of time (Csikszentmihalyi, 1990). Games should make players forget that they are participating through a medium, so that the interface becomes invisible or unnoticed by the player (Federoij, 2002). Games should entice the player to linger and become immersed in the experience (Lazzaro, 2004). Flow describes a state of complete absorption or engagement in an activity and refers to the optimal experience (Csikszentmihalyi, 1990). During the optimal experience, a person is in a psychological state where he or she is so involved with the goal-driven activity that nothing else seems to matter. An activity that produces such experiences is so pleasant that the person may be willing to do something for its own sake, without being concerned with what he will get out of his action (Kiili et al., 2012).

The flow element becomes very interesting in contexts like geocaching where the place/time-independent gameplay and integration of physical and virtual world aspects of pervasive gaming are considered in relation to the GameFlow experience model. Pervasive games should enable the player to shift focus between the virtual and physical parts of the game world without losing too much of the feeling of immersion (Jegers, 2007). Like a third case study, the geocacher could be immersed in searching for geocaches, for example: “(...) a personal favorite of mine was finding a cache that turned out to be a lead pipe as part of a series based on the game Clue (the pipe was ‘murder’ weapon). I had to locate several caches first in order to determine the final location of the murder weapon. Very clever, and it might give you an idea or two for something similar” (Ihamäki, 2012a). Geocachers sometimes do not have full awareness of surroundings when they try to find the cache and feel like they are immersed in hunting the caches.

3.8 Narrative experience and clear goals

The narrative has a greater effect on enjoyment than for people who prefer playing games. Therefore, in addition to well-placed narrative in adventure games like geocaching has a significant effect in increasing player enjoyment (Sweetser and Johnson, 2004). The narrative emerges in the interaction between objects and physical locations. First case study, children like walking for cultural heritage road and listen for historical story, mostly they like church and Park of Kirjurinluoto. Children describe for the narrative experiences like “when we left in University Consortium of Pori then we have told that old time crossing on bridge people use for float to cross for river and sometimes peoples were drop on the river” (student of 4th class). Children feel fascinating to solve for problems in exercises and also read for poem to find treasure hunt places (Ihamäki, 2014a). First case children get narrative experiences by moving the cultural heritage road, and listen to the teacher’s historical story and get the spirit of the history by the story.

Stories are narratives that operate as a schematic structuring of temporal episode. Mandler (1984) wrote that “stories have an underlying, or base, structure that remains relatively invariant in spite of gross differences in content from story to story” (p.22). In the fourth case study, users need to think how other users create for geocache, for example geocacher says, “I need to imagine where that other player will hide the geocache, because coordinates give only one hints not to take me exactly the place where geocache is ‘situated’”. Community members give others ideas to create something new.

The story sequence begins with a setting in which the narrator introduces the characters, the location and the time in which the story takes place. After the setting has been established, the story proceeds with one or more episodes, each of which has a beginning and a development. In the episode, the character, reacting to the beginning events, sets a goal and outlines a path to attain the goal. Each episode includes the outcome of the attempts to reach the goal and assumes that the attempts are understood as the causes that bring about the outcome. When the outcome has been given, the episode ends, and the ending links the episode to the whole story. After a series of episodes has been presented, the narrative includes ending portions that show that the
episodes coalesce into one story (Polkinghorne, 1991). Similarly, in geocaching, geocachers introduce geocache places; some places have public well-known stories and some have special stories based on geocachers’ own experiences. Geocaches create their own narrative structure for the game, each geocache has a unique narrative because different players (6 million player) create own way for geocaches. Geocachers want to create very creative way for caches – for example, extreme caches in terms of weather, or caches that are in unique and beautiful landscape places. As the geocaching is a game and narratives of the cache have clear goals, first narratives introduce for place and give some hints on how to find the place with the help of coordinates. The story continues with players’ own experiences when they find the cache place and publish their own narrative experiences on geocaches own web page.

3.9 Summary GameFlow experience model

The case study applications go through of evaluation phases. The studies of five cases application support GameFlow experience model elements, which was shown in empirical data gathered. Looking at the shifts between components of the GameFlow experience model is a useful way to begin to understand user–product interactions, how they relate to GameFlow experience model of talking about experiences, and what types of experience we might design for. Armed with this initial GameFlow experiences model as a tool, how can designers conceive of designing certain types of experiences? Initially, we can pay attention to particular components within the GameFlow experience model, maintaining sensitivity for what kinds of user–product interactions and kinds of experiences each offers, understanding what qualities of experience each might be predisposed to create, and how those experiences and qualities might shift over time.

By collecting and understanding subjective player experiences, and synthesising them to construct a formalised narrative in the form of pervasive adventure concept, we can create beneficial services and experiences. Once we understand experiences, designers will be able to use it as a source of information for creating pervasive adventure services that improve the quality of life. Perhaps eventually we can help people to understand their own experiences and transform them into the pervasive adventure services that carry personal and social value form enjoyment. This research has led to a common way to talk about experiences, understanding what influences experiences and what kinds of experiences can be created and how experiences shift over time. Through qualitative player experience research for the design of new pervasive adventure services, I have begun to test and refine this theory.

4 Design guidelines

Based on the empirical findings and result of the GameFlow experience model presented in the paper, the users suggest guidelines for designing pervasive adventure concepts.
Example: The adventure mobile game could be used as an educational experience tool, which companies could use for functions like team-building days, or teachers could use in education for any subject.

5 Narrative experience tool for pervasive adventure concepts

Description: The adventure mobile game should support a narrative experience tool. The narrative emerges in the interaction between objects and physical locations.

Motivation: Good and exciting stories motivate participants. Also, users get a description of history of the places or a mystery story based on the places.

Example: The adventure mobile game will offer narrative experience in the world. The finding caches is part of the narrative experience; the story sequence begins with a setting in which the narrator introduces the location and the time in which the story takes place (Polkinghorne, 1991). Users hunt for a narrative experience by finding new places with new stories.

5 Conclusions and future works

This study evaluates five case studies provided insight into how the elements of GameFlow experience model fit in pervasive adventure games in the context of education and tourism and what makes pervasive adventure games enjoyable and the relative importance of each GameFlow experience element. Concentration seemed to be particularly important for making pervasive adventure games enjoyable, with player enjoyment pivoting on mastering, scheduling and coping with the numerous tasks. Result presents the empirical findings that support the theory, which presents GameFlow experience model.

- **User and player experience** appropriate series of distinct and challenging situations (Smith, 1999) that are calculated from careful level and design a positive game experience that results in player wants to continue to playing game (Desurvire et al., 2004). Geocaching offers players different challenging experiences which lead user experiences.

- **Social experience and co-experience** in fact is the topmost motivation for playing digital games (Tychsen et al., 2006). Social experience has the real and present friends, or mediated human co-players, which come as a natural role of social setting in player enjoyment (Ermi and Mäyrä, 2005). Geocaching offers social experience and co-experience, for example in geocaching events, team-building geocaching and GroundSpeak Forum conversations.

- **Player creative experience** the responsibility is on the users themselves to actively learn about their surroundings and develop their own skills (Richards and Wilson, 2006). Geocaching has given the game where users can create new content and they get merits from geocaching community when they create something new. Creativity is key issue in geocaching game for users.

- **Emotion experience** could define as a complex construct with physiological, affective and cognitive dimensions and is the core elements of entertainment media like games (Vorderer et al., 2004). Geocaching gives positive experience for players and its important reason to continue for playing geocaching game and user more likely to engage in the activity for its own sake.

- **Temporal experience and control** in game could see as intense and focused concentration on what one is doing in the present moment. Experience of the activity as intrinsically rewarding, such that often the end goal is just an excuse for the process (Nakamura and Csikszentmihalyi, 2002). Geocaching could play temporarily, even holidays, and there are almost endless challenges to greater techniques or creativity to control on playing game.

- **Educational experience** user accumulates a growing reservoir of experience that becomes an increasing resource for learning (Baird and Fisher, 2005). Geocaching has given platform to users to motivate to learn of others’ experiences, for example extreme geocaching with increased possibilities to co-experience things and learn new things with others.

- **Flow experience** could see as psychological state where user is so involved with the goal-driven activity, nothing else seems to matter. Geocachers offer player the platform, where player has been so motivated that when they are searching geocache they do not even see the time to spend it.

- **Narrative experience and clear goals** have an underlying or base, structure that remains relatively invariant in spite of gross different in content from narrative to narrative (Mandler, 1984, p.22). Users have created narrative experience with geocaching and shared own narratives with geocaches. Users share own narrative experiences with each geocache.

In the current form, the GameFlow experience model elements could be used as the guidelines for designers, researchers and they could be used as the basis for constructing other types of evaluation (player-testing). Design guidelines are users’ suggestions for developing the pervasive adventure applications in the playing geocaching or other adventure pervasive games, which supports the GameFlow experience model. Empirical findings and the GameFlow experience model support new elements, like a mixed reality component, narrative an experience component, educational experience, social experience (social network services), and tracking system in adventure game design. This intent of the analysis in this research is to suggest that GameFlow experience model’s eight components of pervasive adventure concept design that may provide guidance in the design of activities such as enjoyment of adventure game, problem-solving exercises, and social pleasurable experiences within interactive and game-based mixed reality environments.
I have found that mixed-reality components seem to be an interesting new feature in the geocaching game. Therefore, I suppose that mobile and ubiquitous computing will offer new possibilities in the future for further developing geocache concepts. These services should enrich experiences but at the same time be invisible. For example, the use of pressure or motion detecting sensors as a part of infrastructure of mystery geocache location would provide information of user’s behaviour in an invisible manner, and thus enrich geocaching experiences (e.g. in sport geocaching). Finally, the GameFlow experience model serves for academics and game developers to understand enjoyment in pervasive adventure games and to conduct further research into evaluation and designing enjoyable pervasive adventure games in the context of education and tourism.

Acknowledgements

Author thanks all of the participants that contributed to this research. Author would like to express his special thanks to Mika Luimula who contributed one case study.

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