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USER EXPERIENCE OF GEOCACHING AND ITS APPLICATIONS TO TOURISM AND EDUCATION

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Abstract

Advances in technology have provided new ways of using entertainment and game technology to foster human interaction. Games and playing with games have always been an important part of people's everyday lives. Traditionally, human-computer interaction (HCI) research was seen as a psychological cognitive science focused on human factors, with engineering sciences as the computer science part of it. Although cognitive science has made significant progress over the past decade, the influence of people's emotions on design networks is increasingly important, especially when the primary goal is to challenge and entertain users (Norman 2002).

Game developers have explored the key issues in game design and identified that the driving force in the success of games is user experience. User-centered design integrates knowledge of users' activity practices, needs, and preferences into the design process. Geocaching is a location-based treasure hunt game created by a community of players. Players use GPS (Global Position System) technology to find "treasures" and create their own geocaches; the game can be developed when the players invent caches and used more imagination to creations the caches. This doctoral dissertation explores user experience of geocaching and its applications in tourism and education. Globally, based on the Geocaching.com webpage, geocaching has been played about 180 countries and there are more than 10 million registered geocachers worldwide (Geocaching.com, 25.11.2014). This dissertation develops and presents an interaction model called the GameFlow Experience model that can be used to support the design of treasure hunt applications in tourism and education contexts. The GameFlow Model presents and clarifies various experiences; it provides such experiences in a real-life context, offers desirable design targets to be utilized in service design, and offers a perspective to consider when evaluating the success of adventure game concepts.

User-centered game designs have adapted to human factor research in mainstream computing science. For many years, the user-centered design approach has been the most important research field in software development. Research has been focusing on user-centered design in software development such as office programs, but the same ideas and theories that will reflect the needs of a user-centered research are now also being applied to game design (Charles et al. 2005.)

For several years, we have seen a growing interest in user experience design. Digital games are experience providers, and game developers need tools to better understand the user experience related to products and services they have created. This thesis aims to present what the user experience is in geocaching and treasure hunt games and how it can be used to develop new concepts for the treasure hunt. Engineers, designers, and researchers should have a clear understanding of what user experience is, what its parts are, and most importantly, how we can influence user satisfaction. In addition, we need to understand how users interact with electronic products and people, and how different elements synergize their experiences. This doctoral dissertation represents pioneering work on the user experience of geocaching and treasure hunt games in the context of tourism and education. The research also provides a model for game developers who are planning treasure hunt concepts.

Tiivistelmä

Teknologinen kehitys on tarjonnut uusia tapoja hyödyntää viihdettä ja peliteknologiaa ihmisten välisessä vuorovaikutuksessa. Pelit ja niiden pelaaminen on ollut aina tärkeä osa ihmisten arkipäivää. Ihmisen ja tietokoneen välisen vuorovaikutuksen tutkimus, human-computer interaction research (HCI), on perinteisesti nähty kognitiivisena psykologiana, johon kuuluvat inhimilliset tekijät, sekä insinööritieteenä, johon sisältyy tietojenkäsittelytiede. Vaikka kognitiivinen tiede on kehittynyt viime vuosina valtavasti, suunnitteluverkostoihin vaikuttavat ihmisten tunteet ovat yhä tärkeämmässä osassa, erityisesti silloin kun tavoitteena on haastaa ja viihdyttää käyttäjiä. (Norman 2002.)

Pelinkehittäjät ovat selvittäneet pelisuunnittelun kannalta olennaisia tekijöitä ja tunnistaneet, että pelien menestyksen salaisuus on käyttäjäkokemus. Käyttäjäkeskeisessä suunnittelussa käyttäjien toiminnan käytäntöjen, tarpeiden ja toiveiden tuntemus tuodaan mukaan suunnitteluprosessiin. Geokätköily on paikannukseen perustuva aarteenetsintäpeli, jonka pelaajat ovat luoneet yhdessä. Pelaajat käyttävät GPS-teknologiaa "aarteiden" etsimiseen ja lisäävät omia geokätkökohteita ja peli kehittyy jatkuvasti pelaajien keksiessä kätköjä, jotka vaativat yhä enemmän mielikuvitusta. Tässä väitöskirjassa tutkitaan geokätköilyn käyttäjäkokemusta ja sen sovelluksia koulutuksen- ja matkailunaloilla. Perustuen Geocaching.com websivustoon geokätköilyä pelataan noin 180 maassa, ja rekisteröityneitä käyttäjiä on yli kymmenen miljoonaa eri puolilla maailmaa (Geocaching.com, 25.11.2014). Tässä tutkielmassa esitellään vuorovaikutusmalli nimeltään GameFlow Experience -mallia, jota voidaan käyttää aarteenetsintäsovellusten suunnittelussa koulutuksen- ja matkailualojen konteksteissa. GameFlow Experience -malli esittelee ja selventää erilaisia kokemuksia – se esittelee ne todellisessa kontekstissa, tarjoaa erilaisia suunnittelutavoitteita palvelusuunnittelua varten sekä näkökulman, joka tulisi ottaa huomioon seikkailupelien menestystä arvioitaessa.

Käyttäjäkeskeisessä pelisuunnittelussa on sovellettu inhimillisten tekijöiden tutkimusta valtavirran tietojenkäsittelytieteeseen. Useiden vuosien ajan, käyttäjäkeskeisen suunnittelun lähestymistavasta on tullut tärkein tutkimusala ohjelmistokehityksessä. Tutkimus on keskittynyt ohjelmistojen kehitykseen käyttäjäkeskeisessä suunnittelussa etenkin toimisto-ohjelmistoihin, mutta samoja ideoita ja teorioita, jotka heijastavat yhteiskunnan tarpeita käyttäjäkeskeisessä tutkimuksessa sovelletaan nyt myös pelisuunnitteluun. (Charles ja ym. 2005.) Kiinnostus käyttäjäkokemuksen suunnitteluun on kasvanut jo useiden vuosien ajan. Digitaaliset pelit tarjoavat kokemuksia, ja pelisuunnittelijat tarvitsevatkin työkaluja, joiden avulla voidaan entistä paremmin ymmärtää tuotteiden ja palvelujen luomia käyttäjäkokemuksia. Tutkimuksen tavoitteena on esitellä käyttäjäkokemusta ja miten sitä voidaan käyttää uusien aarteenmetsästyskonseptien kehittämiseen. Insinööreillä, suunnittelijoilla ja tutkijoilla tulisi olla selkeä käsitys siitä, mikä käyttäjäkokemus on, mitkä ovat sen osat ja mikä tärkeintä, miten voimme vaikuttaa käyttäjän tyytyväisyyteen. Lisäksi pitäisi ymmärtää, miten käyttäjät toimivat elektronisten tuotteiden kanssa sekä miten ihmiset toimivat vuorovaikutuksessa toistensa kanssa ja miten eri osat vaikuttavat yhdessä käyttäjien kokemuksiin. Väitöskirja on pioneerityö käyttäjäkokemuksesta geokätköilyssä ja aarteenetsintä peleissä matkailun ja opetuksen kontekstissa. Tutkimus antaa myös mallin pelin kehittäjille, jotka suunnittelevat aarteenetsintäkonsepteja.

Preface

This research journey started straight after I finalised my master thesis in 2006. This subject, geocaching game and its applications to education and tourism got my attention because it had not been widely studied before. This journey in writing a doctoral dissertation was long and educative, and I will never forget it. I feel privileged for the opportunities given and support shown by so many people. I would like to thank my supervisor, Jaakko Suominen, Professor of Digital Culture, for his support and freedom to focus on my own research. I also want to thank my second supervisor Antti Haahti, Professor of Tourism Research in the Faculty of Social Sciences/LUC Tourism (MTI) in Lapland University, he has given me a lot of support in writing my doctoral thesis and encouraged me to presents papers in many conferences. We have attended same conferences and he has always given me constructive comments and feedback of my presentation and papers. I will never forget this support I received from you, Antti Haahti. My many thanks go also to Frans Mäyrä, Professor of Information Studies and Interactive Media, School of Information Sciences, University of Tampere, and Jari Multisilta, Professor of Multimedia, Tampere University of Technology, for reviewing this thesis. I would also wish to thank Professor Jari Multisilta for agreeing to be the opponent in the public defence of my thesis.

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May you enjoy your reading, Pirita Ihamäki

Contents

List of Publications

This dissertation consists of two parts. Part 1 provides an introduction to the research problem, a description of methods used, an overview of theoretical issues, highlights of two different case areas, a picture of implications of geocaching and the treasure hunt concept, and final results and conclusions.

Part 2 is a collection of publications, related to the theme of the dissertation, that the author has published alone or together with her colleagues in the years 2012–2014. The publications are reproduced by permission of the publishers and they are referred to in this thesis using the numerals P1–P6 and as the first to sixth case studies.

Geocaching and the treasure hunt concept vision in adventure education

P1 Ihamäki, P. (2014) The Potential of Treasure Hunt Games to Generate Positive Emotions in Learners: Experiencing Local Geography and History using GPS Devices. Special issue, *International Journal of Technology Enhanced Learning*, Vol. 6, No. 1, 5–20.

P2 Ihamäki, P. (2015) Design the Pori Hidden Beauties Geocaching Series: Computer-Supported Collaborative Web-Based Learning and Sharing Experiences. Special issue, *International Journal of Web Based Communities*, Vol. 11, No. 2, 131-152.

Geocaching and the treasure hunt concept vision in adventure tourism activity

P3 Ihamäki, P. (2012) Geocachers: The Creative Tourism Experience. *Journal of Hospitality and Tourism Technology*, Vol. 3, No. 3, 152–175.

P4 Ihamäki, P. (2013) Geocachers' Creative Experiences Along Coastal Road in Finland. *International Journal of Leisure and Tourism Marketing*, Vol. 3, No 3, 282–299.

Design implications of user experience to geocaching and the treasure hunt concept

P5 Ihamäki, P., and Luimula, M. (2013) Understanding the User Enjoyment with Geocaching Application. *Journal of InfoCommunication*, Vol. 5, No. 4, 17–26.

P6 Ihamäki, P. (2014) GameFlow Experience Model: Understanding Player Enjoyment in Pervasive Adventure Games. *International Journal of Wireless and Mobile Computing*, Vol. 7, No. 6, 536–548.

List of Acronyms and Terms

CA	Cognitive absorption (CA) is a state of flow in the study of user behavior. Agarwal and Karahanna (2000) described dimensions of CA in the context of software (temporal dissociation, focused immersion, and enjoyment control) and claimed that personal innovativeness and playfulness can predict CA.
Context	According to Dey (2001), context is any information that can be used to characterize the situation of an entity, such as social, cultural, and physical or task context.
Context awareness	According to Dey (2001), context awareness can be seen as a system in using context to provide relevant information or services to the user, where relevancy depends on the user's task.
GPS	A Global Positioning System (GPS) is used generally to service for positioning. In GPS devices or smartphones, GPS coordinates target a certain position in a geocaching game.
HCD	According to Henninger (2000), human-centered design (HCD) is a development process for gathering knowledge about interface design in a form that can capture relationships between specific development contexts and applicable methods, tools, and heuristics.
HCI	Human-Computer Interaction (HCI) is a discipline concerned with the design, evaluation and implementation of interactive computing system for people use and with the study of major phenomena surrounding them (ISO 2010).
MR	Milgram and Kishino (1994) defined mixed reality (MR) as a collective term for concepts concerning the integration of the real and virtual realms.
SAM	The self-assessment manikin (SAM) method directly measures emotion. Lang (1980) and Hodes Cook, and Lang (1985) developed this picture-oriented instrument and described the pleasure occurring in direct response to an object or event.
UCD	*"User-Centred Design [UCD] is based on a design process on information gathered from people who will use the product"* (ISO 13407 1999)
UX	User experience (UX) is defined as *"a person's perceptions and responses that result from the use and/or anticipated use of a product, system or service"* (ISO 2010).

1 Introduction

1.1 Context

Christopher Columbus was an explorer and the most well-known navigator to sail the Atlantic Ocean, which he crossed in 1492, during his first voyage. Technology has changed navigating, but it is still as interesting as ever. Geocaching is a game carried out by players who use GPS technology in a new way and develop it continuously; it can thus be seen as a pilot test area for game designers and developers. Such designers and developers have recognized the crucial importance of developing games, and the driving force in this is the user's experience. In user-centered design (UCD), the integration of knowledge of players' work practice, preferences, and so on into the design process is crucial to its success.

The Geocaching game can be considered as the most famous treasure hunt game. Geocaching is played worldwide by using smartphones to search for coordinates and find the geocache sites. Geocaching has quickly spread all around the world; it is enjoyed by more than 10 million registered users on Geocaching.com and more than 2,5 million geocaches are waiting to be found in over 180 countries. Geocaching is the practice of finding items at various locations around the world by using Global Positioning System (GPS) coordinates provided by the person who placed the item. The items are located in containers called caches. A cache can be anything from a large container (for example one of the biggest geocache in Germany: GC4XP2T geocache is 3x4 m and 2.5 m high) to a micro-container that a small rolled up slip of paper can barely fit in. Such caches may contain a variety of items, most importantly of all, the log for each player to sign his or her username and date he or she found the cache. It can also contain trinkets people leave, such as pens, small toys, painted rocks, or anything else the user wants to leave behind. There is a general rule that if a player takes something from the cache, he or she must leave something for the next person to find (Geocaching.com).

Geocaching connects new technology, outdoor life, and people in many ways. Players are now starting to bring geocaching into everyday life and are setting up, crossing, and breaking the boundaries between game and non-game. Comprehensive studies of geocaching have just begun, and only a few studies have focused on the Geocaching game itself, which is often used in education. This is one motivation for the work in this dissertation. A second motivation is that this extensive study could be used to explore user experiences in the Geocaching game and find solutions for UCD of pervasive games in the context of tourism and education. The third motivation is to continue the development of UCD models in pervasive adventure games for tourism and education applications. This doctoral dissertation is limited to the use of Geocaching in education and tourism. Education is important in this context because in the beginning 2001, geocachers saw a huge potential for Geocaching to be used as a pedagogical tool. There are many websites to show educators how to use Geocaching in education. In Finland, a geographic information system (GIS) became a requirement to teach high-school geography courses in 2005. On the other hand, for

tourism, there is huge potential for using geocaching and similar digital games in this industry. Yet, there has been no extensive academic research focusing on Geocaching in tourism.

Taylor (2006) noted that "virtual" spaces leak into the "real" world, and that the practices of play are integrated with those of everyday life. UCD makes it possible to design games comprising many different and subjective definitions of stages of the innovation process. Its solutions adapt to different design methods by using different game plans to meet users' needs. This leads to many alternative technical solutions being evaluated by lead users (Taylor 2006). Cooper (1999) asserted that UCD is "goal-oriented design," and follows product development thinking. This approach defines what kind of software development should be carried out and how it should proceed together with the users' input (Cooper 1999).

The user experience (UX) has been studied for some time, and human-computer interaction (HCI) researchers have proposed a variety of models from different perspectives. The UX has been often defined as fun, producing pleasure and enjoyment. The user experiences seem to be designed to focus on the user's enjoyment of creation (Korhonen, Montola, and Arrasvuori 2009; Roto 2006). Csikszenmihalayi (1991) defines the concept of flow as being valuable. It is something special to satisfy the basic needs of the users. It goes beyond of the definition that reflects the positive experience of the senses to provide a positive flow from the other people involved and work experiences. A personal experience can be seen as a key factor in creating positive experiences (Csikszentmihalayi 1991). Shedroff (2001) specifies that the experience is a subjective element and is difficult to measure. However, parts of the experience are separable and reproducible, and some can be predicted (Shedroff, 2001). This approach will allow the user to create ways of experiencing media, and mediated negative situations can be turned into positive experiences. The categorization of the term "experience" into different facets helps to identify and design elements of experience (Buccini and Padovani 2007). The main purpose is to understand the players' experience, what aspects make an enjoyable experience for the player, what kinds of experiences the game can provide, and how to design something that causes a certain type of experience during the reaction, for example, to searching a geocache (Korhonen et al. 2009).

Game design is seen as a different task to merely designing the usefulness of applications. The game design process can be associated with the experience of the planning process, such as a movie script, as well as a part of the UCD. Users and their social environments represent an integral part of this process. From a game design point of view, the adaptation of the players in planning is an important part of the whole process (Ermi and Mäyrä 2005a).

This doctoral dissertation presents the results of user experience related to geocaching. The outcomes of the dissertation extend the scope of UX in the game design field by introducing the GameFlow Experience model. The results demonstrate that in many case studies, user game flow experiences are supported by using Geocaching in the tourism and education context. Users engage in flow experiences because flow is included in the situation of the geocaching game activities in education and tourism, which involve social experiences, and users have the ability to communicate and interact with others during gameplay; this is demonstrated in the doctoral dissertation publications, for example, publications P1, P2, P5, and P6.

A comprehensive review of the literature on UX in game design was conducted to determine how elements of flow are manifested in computer games. This dissertation presents the GameFlow Experience model for pervasive games, a model that was constructed based on the literature review and empirical findings of this research. The GameFlow Experience model consists of the following eight elements: player experience, social experience, creative experience, emotional experience, temporal experience, educational experience, immersion experience, and narrative experience. The model's elements are based on the UX and game design literature, including elements such as user and player experience, pervasive game design, gameplay, flow consequence, and narrative. The GameFlow Experience model can be used to design, evaluate, and understand users' positive experiences with pervasive treasure hunt games in the contexts of tourism and education. While the term "GameFlow" has been used before, for example, by Sweetser and Wyeth (2005) and Jegers (2007), the GameFlow Experience model of this research is based on user experiences related to geocaching and treasure-hunting applications in the contexts of tourism and education (P1, P2, P3, P4, P5). Sweetser and Wyeth's (2005) GameFlow model consists of eight elements: concentration, challenge, skills, control, clear goals, feedback, immersion, and social interaction. Their model is based on heuristics found in the literature, including elements such as game interface, mechanics, gameplay, and narrative. Sweetser and Wyeth (2005) have integrated these heuristics into a validated model that can be used to design, evaluate, and understand enjoyment in games. Jeger (2007) has conceptually and theoretically analyzed and elaborated on GameFlow models in terms of their applicability in pervasive gaming, as well as created his own pervasive GameFlow model. Jeger's Pervasive Game Flow model consists of the following components: concentration, challenge, player skills, control, clear goals, feedback, immersion and social interaction.

It is important to evaluate player experience in popular games like geocaching because designers and researchers could learn important aspects of designing new games or using games in a totally different context, such as tourism and education, as in this research. The context of education and tourism employs game flow and gameplay aspects for use the in geocaching game by producing new education methods or tourist services. The paradigm includes a UCD and is based on the desire to allow players to participate in the development of the software. This is considered to be an important source of information throughout the design process (Ermi and Mäyrä 2005a).

1.2 The Geocaching game concept

According Montola et al. (2009), the treasure hunt represents the oldest genre of games, and is one of the most well-established and well-known game concepts. For example, letterboxing started in Dartmoor, England in the middle of the 19th century. This is a form of treasure hunt where the aim is to find a bow with a logbook and an individual stamp based on hints received from others (Montola, Stenros, and Waern 2009, 32).

Nieuwdorp (2007) examines pervasive games from the technological and cultural points of view. The technological perspective looks at how to utilize pervasive computing, while the cultural perspective focuses on the game itself in the physical world. Pervasive games can have

objects and properties, such as building the physical world in the game. Since pervasive games can be played at any time, anywhere, and by anyone, the game features support the temporary action of playing the game (Montola, Stenros, and Waern 2009, 17) Montola et al. (2009) have defined treasure hunt games as pervasive games, and Geocaching is one of these. Pervasive games expand temporally from explicit play sessions; here, the socially constructed game session is interlaced and mixed with ordinary life (Montola 2005). In Geocaching, every action the player does until the game is over might be a game action. In pervasive games, social expansion takes place when the game expands socially, obfuscating the boundary of players' memberships. In the unexpected places and times where the expanded games are played, unexpected people make a difference regarding the gameplay. A pervasive game is a game that has one or more salient features that expand the contractual magic circle of play in a social, spatial, or temporal sense. Pervasive gaming is not limited to the contractual play spaces of the traditional magic circle of gameplay, which means that participating in a pervasive game directly influences the ordinary life of the player. Thus, the game is no longer isolated from ordinary life. The game genre associated with this pervasiveness seems to be an extension of earlier gaming phenomena, using traditional elements in a new gaming culture. Pervasive games exploit the spatial, social, and temporal dimensions to successfully produce genuinely different experiences (Montola 2005).

User innovation changed treasure hunt game played by children into treasure hunt games played by adults of all ages in the digital era; such games include geocaching with smartphones. Technology enthusiasts and explorative seekers have the opportunity to learn about the latest trends in the hobby of geocaching, which is suited for health-promoting entertainment games. According to the official Geocaching webpage Geocaching.com, a group of Finns has started this game in the 1980s as an orienteering treasure hunt using a map and compass. The group started to use GPS devices in the 1990s, and this group is considered to represent the pioneering geocachers (Ihamäki and Tuomi 2009). However, Geocachers has defined the geocaching has been started after President Clinton's administration gave the public the opportunity to use the GPS system in May 2000. Geocaching is the 21st century is equivalent to a scavenger hunt, where geocachers use their GPS units to find hidden treasure. The story of the Geocaching game has been begun when Dave Ulmer placed the first cache near Portland in May 2000 (Sherman 2004). The word *geocaching* comes from "geo-" for geography and "caching" as the process of hiding the cache, or treasure. A cache is a computer term that means storing data in memory, but the term is also used in camping and means hiding something to preserve it. The terms "GPS Stash Hunt" or "Global Positioning Stash hunts" were the first names used for this game before the name "Geocaching" stabilized. Webb (2001) was the first researcher to investigate the geocaching game, arguing that it has benefits for other contexts such as education. This means that Geocaching is more than game: It is a unique pervasive adventure game that has benefits for education, tourism, companies' team-building exercises, wellness business, and other contexts, the only limitation being people's creativity.

Picture 1. Instruction on how to use a GPS device and play geocaching at the Paasikivi Institute in Turku, 2006 (photographer: Tuukka Erkkilä).

In Geocaching, the pleasure of seeking is in the seeking itself, not in an elaborate stimulation of seeking for geocaches. Exploring, seeking, puzzle solving, and hunting for treasures are activities carried out in the real world. The whole game is still a media event, which can be seen as a temporal experience (e.g., de Zengotita 2005), but the individual cases and the action during the game create a seemingly direct experience (Montola 2007). This means that if a player goes geocaching with his or her school class, the experience of Geocaching is only mediated through the context of school and education, even though he or she is still participating in a temporally expanded geocaching game. Geocaching is a pervasive game, and there is no extensive academic research on this game and its application to other contexts. Digital communication channels bring about new varieties of Geocaching community in which computers are connected to pervasive global networks and player moving in real life context. Some of these are extensions of non-digital forms of play, while others offer entirely new experiences and play spaces in real-life context example library. Geocaching is a game generated by players that use the available GPS technology in a new way, develop it continuously, and create more interactive communication channels; it can thus be seen as a pilot test area for game designers and developers (Ihamäki 2012b). Ihamäki and Luimula (2013a) see that it is important to evaluate players' experiences in popular games such as geocaching, as designers and researchers can use these evaluations when designing new pervasive adventure games. New technologies already offer developers significant opportunities to create innovative geocaching services, which could provide better end-user experiences. Geocaching as a business is still quite young and often quite unknown when compared to other games and service areas with millions of users (P5).

1.2.1 Geocaching as Part of Education

Geocaching has been brought forward as an opportunity to implement an innovative educational technology to integrate this strategy that promotes 21st-century skills and reinforces students' active partnerships and sharing of learning experiences (Mayben 2010, 26). Geocaching has been used in education since 2001 (Webb 2001). In his study, Webb (2001) describes utilizing geocaching in education. Students were involved in locations as well as physical places and virtual places, and

they got the points when they find the cache location in the South-East Queensland region in Australia. Students were provided with information about the difficulty of the terrain in a geocaching game sent to them in the group called "Ideology Geocaching." Queensland University of Technology (QUT) students participated in this program and hid nine geocaches in the South-East Queensland area. The result of study describes global position systems and the Internet is opening up new and exiting spatial odyssey adventures. Webb challenge surveying profession well placed in terms of providing leadership for spatial information data gathering and dissemination of these new applications. (Webb 2001). Educators have introduced Geocaching into their teaching. Technology expert Lynn Lary (2004) implemented a two-day "outdoor school" and encouraged her students to use their mathematical skills and problem-solving skills to identify different clues for the geocaching game. Mathematics teachers have used Geocaching to help students to solve logical problems, to remember and use mathematical concepts, and to explore angles and distances (Kerski 2006; Lary 2004; Trimpe and Hughes 2005). Schlatter and Hurd (2005) discuss how map skills, math skills, and historical information can be integrated with physical education activities in which students run to different caches on school grounds. Moreover, Buck (2009) used a pretest and post-test given through the New Century Education (NCE) mathematics software program to assess student achievement levels before and after treatment. The study results revealed that students made progress in mathematics achievement, but because the students in the control group outperformed those in the treatment group, the GPS activities were not effective in enhancing student achievement. Buck concluded that the outcome of the treatment indicated improvement in students' attitudes toward mathematics, which could be achieved by using GPS activities.

Schlatter and Hurd (2005) argue that geocaching offers students skills that they can use throughout their lives, which is another important element of the 21st-century teaching and learning process. They also suggest that Geocaching is an example of how technology and physical activity can be combined (Schlatter and Hurd 2005). McCarthy (2005) describes the natural connection of learning styles and instructional geocaching for the kinesthetic learner. The activity of Geocaching requires students to physically search for caches containing information. The hands-on learning environment, where the learner can touch the information and move around the Geocaching course, may thus benefit kinesthetic learners (McCarthy 2005). Sinicki (2006) presents the reasons for incorporating geocaching into the curriculum by stating, "Geocaching is a fun and exciting way to get students outside and exploring the world that surrounds them while using the technology they love" (Sinicki 2006). Broda (2007) describes geocaching in relation to technological standards in that Geocaching activities "*involve elements of teamwork and group problem-solving*." He also states that students must use group processing skills to understand directions, input coordinates, and look for visual clues and the cache (Broda 2007).

Moreover, Shaunessy and Page (2006) have used Geocaching as a tool in social studies and geography. They argue that geography should not be about memorizing facts, but rather asking questions, solving problems, and creating relationships between users and environments. Ihamäki (2007) argues in her research that *"treasure hunt games are new technology skills, a new kind of environmental education and multiplicity pedagogical solutions, which can be considered simultaneously in emphasizing study programmes and to focus on an increase in the significance of courses utilizing position systems"* (Ihamäki 2007). Chavez et al.'s (2004) research on Geocaching

practices included a survey of 133 geocachers in the Minnesota region in the United States. They found that people geocached to enjoy nature, exercise, have new experiences, test their skills, and learn about natural history (Chavez et al. 2004). In his research, Swingle (2007) has encouraged students to study and visit historical landmarks in the surrounding area. Swingle (2007, 4) described their visits to the area, interviewed geocachers, wrote a story, and made a map based on their GPS coordinates. According to Kerski (2006) and Swingle (2007), social studies teachers use geocaching to encourage students to study and visit important local historical landmarks, learn longitude and latitude, and connect content learned in the classroom to actual places and people.

Christie (2007) has presented a model of "What We Learned About GPSs and Geocaching," which focuses on the learning process, and discusses five areas that participants identified as most important, as follows: collaboration, sense of excitement and engagement, mistakes, discovery learning, and teacher considerations. Christie (2007) used the model in a middle school classroom. Ihamäki (2007) used geocaching during a course called "A New Sport Game of Geocaching and Virtual Community Involved in the Game" at the Institute of Paasikivi, Finland in 2006. The course was based on increasing the students' media technology skills with geocaching, such as through GPS devices, digital cameras, and even critical analysis of discussion forums used by virtual communities (GroundSpeak Forum, which is Geocaching.com's official bulletin board for user discussions). In the course, students wrote stories for a newspaper that used geocaching in education. The students used their creativity in developing a multicache called "Poluilla Paasikivi—The Trail of the Paasikivi Institute," which is in Harjattula in Turku, Finland (Ihamäki 2007). A multicache is the cache where the coordinates do not take users straight to the geocache. Instead, they need to find a few consecutive clues and ultimately find the last place, where the geocache is situated. Dixon (2007) reports that teachers have observed increased problem-solving skills and collaboration from students engaged in Geocaching activities. She discusses a virtual geocaching approach in which students are given coordinates and questions to answer about the location. Dixon (2007) provides ideas for creative writing and science experiments that incorporate Geocaching strategies.

Lawrence and Schleicher (2008) examine whether the pedagogical potential of Geocaching can be integrated into university education, for example, through geographic fieldwork. It can be useful as a geographic method, such as in finding the points of the compass or determining spatial bearing via measurement of attitude and distance. According to Lawrence and Schleicher (2008), the purpose of this is to use Geocaching in education and implement educational tasks in geocaches. These researchers have carried out similar research to my own (Ihamäki 2006; Ihamäki 2007; P1; P2). Moreover, Matherson et al. (2008) designed pedagogical activities that use geocaching. These activities are based on the constructivist theory and promote adding new information to prior knowledge, thereby encouraging students to think critically and enabling genuine collaboration and active learning. Geocaching is seen as one method that can be implemented in the development of new skills and standards in innovative teaching and learning (Matherson et al. 2008).

Burns (2013) examines interpretivist and constructivist approaches to the lived experiences of geocachers as they create meaning while engaging with the technology-mediated means to find the Geocaching locations. He focuses on how geocachers perceive their learning

while engaged in Geocaching activities, such as hunting for caches, hiding caches, participating in online discussion forums, and performing face-to-face geocaching. Burns' master's thesis does not measure the geocachers' learning; he is more interested in their activities (Burns 2013, 13). This literature review of geocaching in education shows that using Geocaching in education does not measure of the learning of educational subjects. Geocaching can more or less be seen first of all as a teaching method for school subjects that combines theoretical knowledge with practice. For example, students need mathematical skills to calculate distances what they are searching for geocaches.

Bragg, Pullen, and Skinner (2010) describe the experience of their school-based geocaching undertaken with children in prep (age 5–6) and senior primary grades (age 10–12). They argue that Geocaching provides an opportunity for rich engagement with key mathematical concepts, which goes beyond what can be achieved during a typical lesson. Ihamäki (2014a) presented her first case study, which involved letterboxing and Geocaching played through five waypoints rooted in the history, culture, and landscape of the city. At the waypoints (geocaching places), some educational tasks were given that were connected with the history of Pori, Finland and changes in its landscape. The letterboxing offered leads on a map for younger students, while older students obtained leads for Geocaching by using smartphones with GPS to find the cache locations (P1). Ihamäki (2014c) presented six teachers' experiences in an elementary school in Pori. These teachers were using a new education tool—the letterboxing method—in their teaching. As this discussion of Geocaching has indicated, Geocaching is an emerging recreational activity with potential for becoming an instructional strategy. The study results showed that Geocaching is useful because it engages and excites students involved in the learning process, as well as addressing various learning styles. However, as effective as Geocaching has shown to be in theory and experience, there is still need for empirical data to support instructional Geocaching as a learning tool for student achievement. Ihamäki (2015a) presented students of University of Turku Degree Programme Cultural Productiona and Landscape Studies learning experiences with paractised project work together on a tight timetable and completed collaborative learning exercises in classroom sessions and on facebook. In this case study, students created a geocaching series representing the Pori City National Park area and used it as part of their exhibition. Contribution of the study was to created geocaching series part of the exhibition with using collaborating learning tools and innovative techniques to creating work, which student will experiences in the future project work environment (P2). In this literature review, studies did not show student achievement in the subjects themselves. Geocaching could become a respected tool in education like other technology integration strategies such as Second Life, educational blogging, educational Facebook strategies, podcasting, digital storytelling, and so on (Mayben 2010, 42).

As shown in this summary of the literature review of Geocaching in education, Geocaching has mostly been used to teach problem-solving skills and measurement of distance in relation to school subjects like mathematics, history, and geography. The aim of this literature review is to determine how Geocaching has been used for teaching, and not to become familiar with the theoretical learning theories or methods. On the other hand, this work is not intended to measure the learning itself, but rather to use the Geocaching method of teaching. It is important to encourage students to connect the content learned in the classroom to actual places and people. Geocaching

can offer benefits through collaborative learning; students learn from each other, and at the same time, combine knowledge together. Teachers understand that Geocaching could be easily implemented as a method in any school subject; their imagination is the only limit for this.

1.2.2 Geocaching as Part of Tourism

Geocaching.com has seen the potential of Geocaching for tourism, and therefore the website added a "Geocaching for Tourism" menu in 2012. This resulted in the launch of the GeoTour website, with custom tours showcasing engaging geocaches designed to introduce visitors to new places (GeoTours, Geocaching.com 18.1.2014). Geocaching is an emerging tourism activity, and the perfect way to explore less known tourist sites and experience the great outdoors at any time of year. It is a form of treasure hunting game that utilizes clues from smartphones with GPS, and it is a new way to encourage customers to explore unfamiliar destinations. According to Somers (2012), geocaching tours have been launched in the United States, for example, in Washington, Park County, Colorado in 2012. In another example, the Cache Creek, British Columbia, Canada Geocaching tours go across the region's Gold Rush in the country and there is a total of 144 caches. Somers (2012) comments in his article that *"The Company GroundSpeak Ltd. estimates every $1 spent by a tourist destination on geocaching will result in about $20 spent by tourist on hotels, restaurants and the like. Groundspeak has made a business out of this electronic hide-and-seek game. It offers a free app that shows three nearby caches, a $9.99 app with advanced features and more than 1,750,000 caches, and a $30 annual subscription with additional capabilities such as geocache challenges. The new GeoTours initiative is another way to expand its reach. Destination organizations pay $2,500 to set up the GeoTour and $1,250 annually for promotion and listing fees."*

We can ask what kind of tools geocaching can give to tourism. Our world is the game field, and we already have two million caches all over the world. Geocaching can give small cities and not so well known tourist sights more tourists. It can also keep these tourists in the area longer; for example, as Steel (2010) describes, Shuswap Geo Quest website geocacher James Gjaltema has hidden over 250 caches in his area. His aim is to attract explorer-type customers to the area and keep them there for a longer time. The services in Shuswap Geo Quest describe geocaching events and educational activities in the area (Steel 2010). Ihamäki (2008) claims that geocaching designed as tourism products involving creative experience provides facilities, destinations, and services an opportunity to meet the new needs of the tourism business. She describes that geocaching is an excellent activity for a large group of people who want to maintain a healthy and active lifestyle by participating in a geocaching game that can be enjoyed around the world (Ihamäki 2008, 63). Ihamäki (2012d) describes an article a concrete Word of Art happening with letterboxing, which is targeted to children. An art word can be understood as a certain form of linguistic expression that can also be observed in connection to the system of language. The art word and its theory are part of and shape societal practices. Practice is then understood as a kind of action that is directed toward the natures of phenomena that controls and changes them, as well as people and their needs. Art word reflects the free work of humans and their self-fulfillment (Karkama 1979, 17-38; Ihamäki 2012d). The most significant result of the interaction between the art of the amateur group

discussion, in which the idea was born, was to take this event to a school (indoors), or even to the middle of the forest (Ihamäki 2012d).

Boulaire and Hervet (2012) highlight and conceptualize the potential of geocaching for tourism by describing characteristics from which this new itinerancy emerges. Several actors in the tourism sector are already taking advantage of Geocaching, and the number of followers is continually growing. As part of developing tourism marketing and in the managerial context of looking for innovative strategies to promote a territory, the alliance-territory geocaching seems to have a significant potential to attract consumers geocachers or tourists (Boulaire and Hervet 2012). According to Ihamäki (2012a), the most important research results suggest an increased knowledge of creative tourism, in particular the needs of cachers to share their positive and memorable experience of geocaching, and to introduce new creative tourism services and events created by geocachers. Ihamäki (2012c) examines a Geocaching game on the move event. The geocaching event on the move was unique, since it occurred in a rented tram moving around the city of Helsinki, Finland. Moving in the urban and natural environment is an important part of the geocaching game, as is hiding and finding caches; however, in the case of an event, other aspects become important, such as the novelty of the technology (Ihamäki 2012c, 73).

Ihamäki (2013) describes the assessment of geocachers' *"creative outcomes, and emphasis is placed on participants' subjective experiences"* (their geocache places). This study suggests that the user's own satisfaction with his or her experience is a better predictor of future consumption than the opinion of an objective observer. The study examines the effects of the users' creative experiences along the Coastal Road in Satakunta, Finland. In conclusion, has describe how active users learned from others to create their own creative experiences of using Geocaching and what kinds of benefits they received from the nature tourism destinations. Ihamäki and Luimula (2013a) provide a deeper understanding of enjoyment during a real-time gaming played in the physical world, along with an identification of the strengths and weakness of the GeoCentria application and UX with Geocaching in the tourism context. The study presents design guidelines for adventure game mobile applications in the context of tourism.

To summarize the use of geocaching in tourism, it is quite a new area in academic research, and only a few studies have been done on this topic. Geocaching offers potential activities for the adventure and wellness tourism sectors, from moving in urban and natural environments to producing game concepts to find new kinds of places. Pervasive games have great potential to be incorporated in the tourism business, and this trend has just begun, as this literature review showed.

1.3 Introduction to the Publications

P1. Ihamäki, P. 2014. "The Potential of Treasure Hunt Games to Generate Positive Emotions in Learners: Experiencing Local Geography and History using GPS devices.

Important aspects related to this dissertation: This publication presents the experiences of 2nd- and 4th-class schools in Pori (110 students); the self-report manikin method was used to collect information about students' emotional experiences on the Pori Cultural Heritage Road. The study

gives a descriptive story of children's interactions using treasure hunt games as a creative pedagogical design where technology was exploited to solve clues. The results show that the application of treasure hunt games for education gives a new pedagogical design, which can provident new learning experiences for students and motivate them to learn geography and history while experiencing them at the same time.

The main contribution of this publication was presenting practical examples of geocaching and letterboxing games to create a new pedagogical culture in education. In general, the potential of geocaching and letterboxing treasure hunt games supported by GPS mobile devices to enhance learners' positive emotions was considerable. Letterboxing and Geocaching offer possibilities for students to interact with the game by exploring real environments in order to test geographical and historical hypotheses. Building this link requires that the teacher and designer understand the dynamic features of the interaction in terms of emotions. Thus, the combination of subjects and innovative teaching methods can motivate students to realize good learning results. Thanks to the practical involvement of the environment in teaching, students will be educated to be responsible citizens in the information society.

P2. Ihamäki, P. 2015. "Design 'The Pori Hidden Beauties Geocaching Series': Computer-Supported Collaborative Web-Based Learning and Sharing Experiences."

Important aspects related to this dissertation: The publication presents the creation of content for the Geocaching game titled "The Pori Hidden Beauties Geocaching Series," which has been built on face-to-face classroom sessions and on Facebook social network sessions. The results of study showed how socio-contextual enhancement can increase performance through computer-supported collaborative learning on Facebook and a task-driven geocaching game, while also suggesting that it can increase student activity and engagement when provided in a specific context, as in Pori National City Park in this study, in non-task-driven game environments. This publication provides an understanding of valued learning experience, which refers to pedagogy, content, and community. This course valued the learning experience because students practiced project work together on a tight timetable and completed collaborative learning exercises in classroom sessions and on Facebook. In this case study, students created a Geocaching series representing the Pori City National Park area and used it as part of their exhibition. Thus, students created new content for a geocaching game. The centrality of the student in the project suggests the value of applying user-centered perspectives in studying the geocaching game concept and using computer-supported collaborative learning on Facebook, where students can receive, publish, and modify content.

The main contribution in this publication was presenting both theoretical UX with geocaching in education and a practical example of how to use Geocaching in university student education. The results of this publication indicate that the experience of collaborative learning in creating a Geocaching series in face-to-face classroom sessions and on Facebook was pleasurable for students individually and as a group. The students' pleasurable experiences included an emotional experience (surprise, enjoyment), a creative experience (making a new geocaching series), a social experience and co-experience (collaborative learning throughout the course), a challenging experience (creating a game concept without prior experiences), a temporal experience (the course

timetable was tight), an educational experience (students learning the Geocaching criteria and working on projects with others), a narrative experience (students creating stories as hints based on certain locations), and a mixed reality experience (the Geocaching road had QR codes and students used smartphones or GPS devices to search geocaches, connecting both real and virtual worlds). The acronym QR is short for Quick Response. A QR code is a two-dimensional code and the QR code can easily transfer data without typing to the peoples new communication center. In this publication, I have stressed the importance of collaboration, community building, knowledge sharing, and social networking for learning, as well as highlighting the integration of new geocaching series and social software in the learning process.

P3. Ihamäki, P. 2012. "Geocachers: The Creative Tourism Experience."

Important aspects related to this dissertation: The main goal of this case study was to gain a detailed understanding of current and future geocachers' positive and memorable experiences in the creative tourism context. This case study was conducted via an Internet survey for geocachers in 2009, and is based on 52 responses. Secondary material is based on geocaching stories in magazines all over the world, linked to Geocaching.com, that are used in the publication to expand the description of creative tourism products and of how Geocaching is used in tourism or to design new applications around the game.

As a technology-enabled, location-based activity like Geocaching, it has various attributes that make it significant to understand both in itself and to inform our more general understanding of location-based computing practices in the tourism context. First, Geocaching is a location-based experience that has established and sustained itself over several years. As Harper et al. (2006), O'Hara et al. (2007), and Palen et al. (2000) argue, there have been limited field trial studies, and these have not been designed to explore emergent everyday practice with technologies, the factors in creative tourism experiences that shape these practices, and the social meaning they acquire as they become integrated into people's everyday lives. Second, with Geocaching, users participate not only through the consumption of location-based experiences, but also through the creation of these experiences for others. An understanding of user creation practices and motivations, through the lens of Geocaching, reveals an emerging crop of toolkits and applications designed to give users the ability to author and publish their own action-based experiences (Lane 2003; O'Hara 2008). Furthermore, Geocaching is of interest because it comprises both location-based and online elements. Understanding the relationship between in situ and online behavior is an important area of Geocaching creative tourism experience, because users also share their own software in the Groundspeak forum (online). The goal of the Groundspeak Forums is to promote the activity of Geocaching and location-based outdoor games. It is an open forum sponsored by Groundspeak Inc. for discussing all aspects of Geocaching, Waymarking, Wherigo™, benchmark hunting, GPS usage and other Groundspeak-related GPS gaming. The Groundspeak Forums is social network for GPS enthusiasts around the world. (Groundspeak Forum Introduction to the Forums, 2014)

*The main contribution*s in this publication were presenting both theoretical and practical results concerning the creative experience of geocaching in the tourism context. This publication increased

knowledge of creative tourism activities, especially technologically orientated users (geocachers) regarding the sharing of positive and memorable Geocaching experiences, and the design guidelines, which were formed based on the case study. The empirical findings extend creative tourism activities, like the Geocaching game, in tourist services; moreover, the new technology proposed in the geocaching game presents a new way to broaden creative tourism services. Nevertheless, this case study revealed a novel issue that need to be emphasized in the design process of new creative tourism services, namely the significance of meaningful experiences for geocachers in the global network community, which influences competitive global tourist markets.

P4. Ihamäki, P. 2013. "Geocachers' Creative Experiences along Coastal Road in Finland."

Important aspects related to this dissertation: This publication reflects how geocachers utilize their hobby to collect creative experiences when traveling. In this study, a set of independent judges is used to assess geocachers' creative outcomes, and emphasis is placed on participants' subjective experiences (their geocache places). Because the users' satisfaction with their experience is likely to be a better predictor of future consumption than the opinion of an objective observer, I have examined the effects of users' creative experiences along "Coastal Road".

*The main contribution*s of this publication were presenting practical results of creative experience of Geocaching in tourism. As result, the study shows that one of the most significant changes on the demand side is the increase in the Geocaching creative experiences of players, causing an increase in awareness. A relatively new tourism area is the combination of creative tourist services and digital games. The central purpose of producing creative experiences is affecting feelings. The aim of a romantic landscape photograph is to evoke different emotional states. This is why the application of Geocaching can be seen as a commodity, producing special creative tourism experiences.

P5. Ihamäki, P. and M. Luimula. 2013. Understanding User Enjoyment with Geocaching Application.

Important aspects related to this dissertation: The aim of this publication is to bring up the theories of the "experience" phenomenon and the evaluation of the GeoCentria application to extend the scope of the experience game design field. We explore and analyze how users experience Geocaching. Based on this analysis, we provide the core elements underlying the phenomena that constitute experience with the GeoCentria application. Our evaluation framework conceptualization provides an understanding and designing for users' experience in interactive pervasive treasure hunt games. Examples of using a geocaching game for new applications like GeoCentria for tourism are non-existent in academic study.

The GeoCentria application was developed at CENTRIA Research and Development, Ylivieska, Finland. In this field experiment, we used the Symbianˆ3 version, which was developed using the Qt software development environment. The application consists of three different main screens, as follows: the map window, the digital compass, and the menu window. Users can select

geocaches, are able to define routes, and can directly toggle between the map view and compass view. Following the selection of a geocache, orienteering can be carried out using the digital compass, which shows the direction of and distance to the cache. The user is able to add caches in various ways. The GeoCentria application supports the LOG file format used by Geocaching.com. Caches, along with background information, can be downloaded from Geocaching.com as simplified LOG files in real time. The GeoCentria application includes some features of social media services, for example, Twitter and Flickr services. We used QR codes where was a hint about a cache nearby and the application would show a dialog box asking whether the user is interested in the hint or not.

*The main contribution*s of this publication were presenting theoretical and practical results related to enjoyment of the geocaching application. The results of the study provide a deeper understanding of enjoyment in real-time gaming played in the physical world, along with an identification of the strengths and weaknesses of the GeoCentria application and UX with the Geocaching game in a tourism context. The results indicate that a combination of pleasurable and fun elements causes a sense of very rewarding, deep enjoyment. In addition, an important precursor to a playful way to find geocaches is matching the person's skills with the challenges associated with the task, with both maintaining a certain level. Most flow experiences occur with activities that are goal-directed (as in this user test), bounded by rules, and require mental energy and appropriate skills. This study's participants felt that the GeoCentria application offered them stimulation and a surprising way to find geocaches.

P6. Ihamäki, P. 2014. "GameFlow Experience Model: Understanding Player Enjoyment in Pervasive Adventure Geocaching Game.

Important aspects related to this dissertation: This publication presents the GameFlow experience model, which is empirically tested through five case studies, with a focus on the interplay between player enjoyment and social context. This study concludes that the GameFlow experience model could be used in its current form to evaluate pervasive adventure games.

*The main contribution*s of this publication were presenting theoretical the GameFlow Experience model, which was tested in the fifth case studies. This model of digital games was constructed from the literature based on the element of flow, and the evidence of empirical findings extended the flow experiences in games. The result is the GameFlow Experience model, which consists of the following eight core elements: 1) player experiences and challenges, 2) social experiences and co-experience, 3) player creative experience, 4) emotional experience and feedback, 5) temporal experience and control in game, 6) educational experience, 7) flow experience, and 8) narrative experience and clear goals. The GameFlow Experience model will help academics and game developers to understand enjoyment in pervasive adventure games and conduct further research into evaluation and designing enjoyable games in the context of education and tourism.

1.4 Research objectives and research questions

This thesis has three main research goals. Table 1. presents research questions. *The first aim* is to understand what kind of UX a Geocaching game offers to users. *The second aim* is find out what are the components of experiences that influencing Geocaching in education, as well as what are the users experiences that affects the treasure hunt concepts in tourism. *The third aim* is to determine what the characteristics of experiences in a Geocaching game are, as well as the game's applications to tourism and education. The outcomes describe the experience elements of all case studies and the final article combines all of the findings in the other articles and presents the model of the GameFlow Experience. The result is UCD evaluation in a pervasive Geocaching game in the context of education and tourism and descriptive levels of experiences.

Scope. This thesis is multidisciplinary, though primarily belongs to the research field of Human-Computer Interaction (HCI). Human-Computer Interaction is a discipline be included in the ways humans interact with information, technologies, and tasks, as well as the design, evaluation, and implementation of interactive computing systems for human use and the major phenomena surrounding them (Hewett et al. 1996). User-experience studies are common within the discipline of digital culture, which examines human experiences with various technological applications. Digital culture is the umbrella subject area of this study, which can be seen as including all digital services (e.g., games, mobile guides, etc.) that take into account user perspectives in terms of interaction with digital platforms. This definition covers one aspect of digital culture, to which this study belongs. This study also relates to the field of game research, which can be seen as a part of digital culture research, in its focus on game design research, which is a complementary part of gaming experiences (Ermi and Mäyrä 2005b). This study focuses on the HCI field concept of UX with respect to its nature and framing, as well as on the consequences of designing and evaluating practices. Empirical work has been conducted in the context of education and tourism.

In more detail, the scope of this doctoral dissertation is to evaluate the user experiences of a geocaching game and its components in the next generation treasure hunt concepts under the geocaching game being played in the context of education and tourism. This doctoral dissertation describes a GameFlow Experience model that can be used to evaluate and design pervasive adventure games in the tourism and education contexts that have potentially innovative aspects. The Geocaching community has identified the potential for software development and the associated set of general user-centered design. The process includes education methods and tourism services. These methods can also be used in other kinds of contexts that share the same features.

Using treasure hunt games in the context of education and tourism is quite new globally. This doctoral dissertation will be the first study that applies treasure hunt games in these two application areas and yields practical design guidelines for destination development.

GPS technology and its use in different mobile devices or connecting of different practices offers several research possibilities and application opportunities. Success in developing and applying new technology does not follow automatically; the significance of research investment and production of new knowledge is becoming more and more important. This doctoral dissertation

examines the scientific community multidisciplinary approach. For the human-computer research field, this dissertation will present design guidelines and new user-centered design methods, and give new information on UX from the player's point of view. Geocaching can offer a new method for pedagogy: It can be used to teach about location information **(P1 and P2)**. For tourism research, this study gives concrete examples of new technological applications for adventure tourism services **(P3 and P4)**. Geocaching and multiplayer pervasive games are relevant for the field of UCD and user experiences, where new concept development is tested in a real environment with lead users. For UCD and UX studies, this research offers a real environment usability test in a geocaching applications and relevant information on users' experiences in a geocaching game **(P5)**. In terms of the game design process, the dissertation offers relevant information about using the GameFlow Experience Model in treasure hunt concept development **(P6)**. Designers and researchers are offered the possibility to design new pervasive games in the context of tourism and education using the model presented in this dissertation.

Table 1. The relationship between research questions and publications.

Research Question	**Publications**
RQ1) What kinds of user experiences does a geocaching game offer for users?	P1, P2, P3, P4, P5, P6
RQ1a) What are the components of the experiences that influencing geocaching in education?	P1, P2
RQ1b) What are the users experiences that affect the treasure hunt concept in tourism?	P3, P4
RQ2) What are the characteristics of experience in the GameFlow Experience model?	P1, P2, P3, P4, P5, P6
RQ3) What kind of design guidelines support geocaching and its applications to tourism and education?	P3, P5, P6

All of the case studies explore user experiences in Geocaching applications in the same way in the context of education and tourism; this is why the first research question has been formulated into what kind of experiences Geocaching games offer for the users. The sub-questions cover certain case studies and their aim is find out what experiences influencing the Geocaching in education and what are the affects of Geocaching in tourism services. The second main question was created based on empirical findings, which formed the GameFlow Experience model. The GameFlow Experience Model is also the subject of the design model for treasure hunt concepts in the tourism and education contexts. The third question supports the second main question GameFlow Experience model and gives design guidelines for Geocaching and its applications to tourism and education.

Method. The thesis contains six extensive UX evaluation experiments of geocaching and a literature review (publications P1–P6). The experiments were carried out in the context of

education and tourism, with relative levels of experience components in the GameFlow Experience model. Each of the experiments included 11–110 participants, forming a broad pool of empirical studies with over 216 participants. This doctoral dissertation has used geocachers nicknames, what geocachers has hoped to be used to recognize own comments in this thesis. Geocachers comments are researcher translations. The experiments were conducted in the field using hybrid data-collection methods containing qualitative descriptions and evaluation, as well as advanced techniques for situational data capture. The literature review defined the framework of the thesis and the central concept of the context of use for quality evaluation studies in this field. The results of these studies have been published in six separate scientific publications. The candidate is the first author in all of these publications, having made a significant contribution in all papers. In addition, the candidate has 24 supplementary publications and conference papers related to the theme of her thesis.

1.5 Results and contributions

The thesis is an article dissertation, which gives an opportunity to look more closely at two application areas of geocaching and to connect them together. The Geocaching game is also a global multiplayer pervasive game, which grows and changes rapidly. Data gathering and documentation are important now because this research area is quite new and untouched. This dissertation has a multifactorial and multilevel function, including many research areas and using a theoretical idea of methodological triangulation based on several points of view. The data triangulation in this dissertation was realized through the Self-Assessment Manikin (SAM) method, focus groups and Internet surveys, contextual interviews (usability test), and an evaluation survey. The “methodological tools” for data analysis were qualitative methods such as content analysis.

This thesis provides both fundamental and applied research contributions. It describes five case studies and presents user experiences in geocaching in the context of education and tourism. This doctoral dissertation serves different targets group by presenting a number of contributions, as follows: *empirical* findings mainly intended for the digital culture, user experience, education, and tourism; *theoretical* contributions for digital culture, game design, user experience, and user-centred design; and *practical* contributions for practitioners (game designers, education developers, tourist planners) of geocaching and treasure hunt games.

The empirical findings of user experiences in a geocaching game in the context of education and tourism towards the GameFlow Experience model are summarized in chapter 5 (along with publications P1–P6). The understanding of the diversity of UX as a value and phenomenon is essential in the specific field of geocaching in the context of education and tourism. The sixth publication offers insight into characteristics that could affect the emergence of adventure concepts.

This doctoral dissertation contributes to the literature by introducing the GameFlow Experience model in relation to the UX characteristics of a geocaching game and its application within the fields of education and tourism (described in section 5.3). The model of this dissertation will help to understand user experiences in relation to this topic, as well as to design new treasure-

hunt concepts and analyze related user experiences with geocaching games. The GameFlow Experience model offers definitions, classifications, and concepts that are relevant to this specific field. Such information is seen as important given the novelty and complexity of the central concept in this thesis: the experiential aspects of pervasive treasure hunt and geocaching games that use the GameFlow Experience model. Chapter 2 goes through the concept of UX. The main contribution is the combination of experience elements of Geocaching in the GameFlow Experience model in both the education and tourism contexts. Finally, the GameFlow Experience model proposes agendas for future research and development in the field of pervasive and geocaching adventure games in education and tourism.

The practical contribution in the education context is presented in publications P1 and P2. The studies open new education platforms for educators; teachers have the opportunity to open their classrooms to the entire world through the use of geocaching and similar treasure hunt game applications, and at the same time, teach students something new using a creative approach. The contribution in the tourism context is presented in publications P3, P4, and the user tests in article P5. The results of these studies include trends for creative tourism experiences; the UX needs to be incorporated into adventure tourism services. All of these case studies are combined in article P6.

1.6 Structure of the thesis

Chapter 2 goes through theory and related works concerning the concept of experience and defines UX. The chapter presents multifaceted aspects of user experiences in academic discussion and a practical overview to design treasure hunt concepts for tourism and education. The chapter is pull together with UX research in the doctoral dissertation.

Chapter 3 presents the theoretical framework of UCD and game design. The various theoretical models are briefly introduced, and a summary of earlier design issues is provided. Furthermore, this thesis describes and contextualizes the results of UCD and game design, as well as pervasive game design considerations in Geocaching experiences and related areas. The chapter highlights the influence of UCD in the context of Geocaching experience and what we need in order to design UX, especially in the treasure hunt concept.

Chapter 4 introduces the dissertation methods that were used in the publications for gathering data. The chapter covers the user, system and context of use, physical context, task context, social context, temporal context, and technological context. Furthermore, it presents how geocaching and pervasive treasure hunt game concepts affect the context of use. The chapter summaries the different cases conducted as part of this thesis, as well as their overall research procedures, participants, and the data gathering and analysis methods utilized in them.

Chapter 5 presents the results of case studies belonging to the scope of education and adventure tourism as part of the thesis. As the education research in the field of UX within geocaching is extensive, various focusing decisions are described on the lessons learned in the empirical findings. The chapter describes user experiences of tourism in the Geocaching game and focuses on new possibilities for tourism services identified through the empirical results. In

addition, the chapter highlights design implications of education and tourism activities and gives practical guidelines for adventure tourism and education operators. Chapter 5 concludes all of the theoretical and empirical findings from the case studies and presents the model of the GameFlow Experience.

Chapter 6 revises the research objectives and contributions. The thesis ends with a conclusion and presents directions for future studies.

2 The Concept of User Experience

The goal of this chapter is to provide an overview of UX from four perspectives. The subsections aims to answer the following questions: What are the ingredients of the aspects influencing geocaching experiences? What are the user experiences that affect the treasure hunt concept's perspective? Subsection 2.2 reviews related work concerning player experience, social experience, creative experience, emotion experience, flow experience, and narrative experience, which reflect on the design of geocaching applications to tourism and education. In this chapter have selected key elements of experiences theories that support the empirical evidence in case studies. These all support the UX, the significant element of pervasive treasure hunt games, in the context of education and tourism. Subsections describes the multifaceted nature of the experiences and give theoretical overview to create a model of the GameFlow Experience that can offer insight into a certain experience in the new pervasive adventure game concept in the contexts of education and tourism. Finally, subsection 2.4 summarizes the chapter.

2.1 Key Elements of Experience

Often, the word "experience" is used for the elements of UX, in which the product is designed and developed. Forlizzi and Ford (2000) present a framework for talking about experiences, which is meaningful for designers and researchers. Their framework presents four components that relate to the dimensions of experience, as follows: *subconsciousness*, *cognition*, *narrative*, and *storytelling*. Each of these components is useful for designers and researchers to think about what kinds of experiences they are creating in the design of certain products and services. The term "subconsciousness" is used to represent the most automatic, or fluent experiences; for example, subconscious experiences include a series of activities that have been collapsed into a routine (for instance, a person's morning ritual or making coffee). Sub-conscious experiences do not compete for our attention and thinking processes, but are used "thoughtlessly." Researchers have described that experience is something that happens all the time: Subconscious experiences are fluent, automatic, and fully learned; meanwhile, cognitive experiences require effort, focus, and concentration. Some of these experiences are related to meanings that have starts and ends. Through stories, they may be elaborated into "meta-experiences," which are names for collections of individual experiences (Battarbee and Koskinen 2005). Wright et al. (2003) focused on what is common to all experiences. They described four states—the *compositional*, *sensory*, *emotional*, and *spatio-temporal* strands, which together form experience.

Norman (1999) discusses products that we only need to learn to use, for example battery-powered drill. The word *cognition* represents the experiences that require us to think about what we do, namely the interaction of unknown products and environments, as well as tasks that require attention, cognitive effort, and problem-solving skills. Cognitive experience may mean that the product offers the user a learning experience. The user can also conceive of a new use for a product that the designer had not even thought of. For example, users started to employ GPS

devices for the treasure hunt game called Geocaching in 2000. Pine and Gilmore (1999) suggested a way of creating value that challenged the mainstream view of traditional product development models and traditional marketing. Their study was based on the claim of experience in terms of the following two concepts: 1) *the extent to which the customer or user participates* (which can vary from active to passive) and 2) *the emotional state and the extent of participation in the experience* (which may vary from immersion to not focusing); Pine and Gilmore 1999. In summary, the experience is the creation of products and services; development tools for creating sales are eligible for the experience of users. This forms a bridge between the traditional planning and design experience. UCD processes consist of different stages of individual modules and build on this process. Here, the user experience is assumed to have a prominent role in combining the different phases and creating new experiences that exceed the expectations of the users and commit users to a product or service.

In this doctoral dissertation Geocaching offers meaningful experiences for user, some geocaching experiences remain in the subconscious of users and can stay on a long-term memories. Geocaching meta-experiences could see as a collection of individual geocacher's experiences in Geocaching community. Geocaching creates collective experiences by to individual players, which share their own experiences with other players.

2.1.1 User Experience

Understanding the needs of users and being able to assess the models are key parts of the UCD process and designing a good user experience, as this relies on the same principles (Roto et al. 2009). Roto et al. (2009) claim that user experience *"is about designing for pleasure and value; the contrast to eliminating usability problems*." User experience is a subjective and holistic concept that is hard to evaluate, since at each moment and for each user, user experiences are different. Different approaches have been adopted to go beyond this understanding in considering other aspects of users' interaction with technical systems. Hassenzahl (2005) differentiates between approaches that focus on non-instrumental quality aspects and others where the role of affect and emotions are taken into account to better understand people's experience of technology. Different lines of research concerning aspects of non-instrumental quality can be grouped into the three categories of *hedonics*, *aesthetics*, and *pleasure as fun*. Hassenzahl and Tractinsky (2006) and Olsson (2012) define three key characteristics that contribute to the UX. The first consists of human needs in the longer non-instrumental manner, which can create a more comprehensive, holistic view through the HCI. This emphasizes that the non-instrumental needs of surprise, intimacy, beauty, and personal growth should be related to the needs of the traditional instrumental manner, such as availability. Another aspect of the emotional impact is the need to understand that the phenomenon may give rise to positive emotions such as friendship, joy, and a sense of pride and not only the avoidance of negative emotions such as sadness, frustration, or loneliness. The third aspect of the user experience is the experiential situation, which links to a temporary position. This means that experience is a unique combination of elements, including when products or services are used (Hassenzahl and Tractinsky 2006; Olsson 2012). Pine and Gilmore (1999) discuss experience economy, where

consumers are looking for a continuous response to new experiences with the products and services they use.

Rifkin (2000) emphasizes that people do not benefit from the value of product themselves, but should instead be offered a quality experience with products. This is critical to the quality expectations and experiences are not the same for all customers. Therefore, it does not make strategic sense to every kind of organization to offer quality experiences. The multidisciplinary HCI community has taken as a key concept of UX. It is actively exploring the phenomenon of new policies and procedures that will be developed around it, and it has become a new conceptual tool to promote the implementation of UCD. Perceived quality of UX represents a critical resource for global business to succeed in the present and future through the organization of memorable events for customers, where the memory itself is commercialized—an experience. (Pine & Gilmore 1999)

Silverstone and Haddon (1996) present the UX of the product of technological adoption, which has three dimensions, namely *commodification*, *appropriation*, and *conversion.* They define *commodification* as all of the activities of both producers and users, leading to the availability of a specific product and a new identity. When users are involved in the process, they *appropriate* it, forming an expectation of ways in which products can become meaningful life routines. Finally, in the *conversion* of the product, it is accepted as a part of their own identity and they use it in their social interactions (Silverstone and Haddon 1996). Mahlke (2005) studied the UX as an umbrella term for the sum of all relevant aspects of the interaction of the user. Moreover, Norman (1999) describes the UX, covering all aspects of interaction with the product. Buchenau and Fulton Suri (2000) discuss the UX as the whole of the subjective experience of using a device or tool for a given situation. Because the UX is formed as a dynamic relationship between the user and the device, application and use of the environment cannot be judged in a vacuum (Buchenau and Fulton Suri 2000).

In a geocaching game, the UX can be generated when a user is looking for a geocache on the Internet and then using his or her smartphone or GPS device to find the geocache, as well as experiencing the adventure and writing about the own experience to other users. At the same time, this individual can read about other users' experiences. In this doctoral dissertation the user experience defined as enjoyed experience to playing Geocaching and users who have more experienced geocaching game will also have more engagement to create and share of Geocaching content. It makes sense that more experienced users should find freedom of expression more enjoyable, as their experience means that they are more likely to want to experiment, try different strategies and try to play the geocaching game in their own way. (Ihamäki, Luimula 2013b, 139)

2.1.2 Player Experience

Play is face-to-face discussion; the action is free, the requirements of the play have an exploratory nature, it is safe, and it is situated in a given context. Play is based on duality, because it is easily recognized as a subjective experience to play and hardly passes through objective analysis. This means that one can learn more by playing oneself. Play is a moment of creating a continuous involvement with the game and the process of actively maintaining context (Guildbaud 2003). Play

has universal dimensions, but also culture-specific aspects (Smith 2010, 95). Huizinga (1992, 19) states that *"Play is older than culture, for culture, however inadequately defined, always presupposes human society, and animals have not waited for man to teach them their playing."* Huizinga defines play as voluntary activity in which people set the terms and timing of their own involvement. Second, play is distinguished from routine affairs by its absence of material consequences. Third, play is separated from other activities through its use of rules, spaces, ideas of time, costumes, and equipment. Fourth, play both honors rules and encourages transgression. Finally, play can promote participants banding together in "secret" . (Heljakka 2013, 194; Henricks 2008, 159). According to Follet (2007), play is often associated with "winning" pleasure emotions (Liberman 1977; Zimmermann 2003). The geocaching comes from hide and seek game, which has been extended to the digital area. People have always liked hide and seek games in history, like in Easter hiding eggs for children, or working friends hiding wine bottles in the woods and competing with others as to who will find them first.

Considering the meaningfulness of play, Salen and Zimmerman (2004) argue that the action takes place between the activity and the outcome of a game, which are both observable (the result of a game action is communicated to the player in a perceivable way) and integrated (an action a player takes has immediate and subsequent effect on the play experience). Thus, by following the line of thought, the player is able to step into a role where players communicate on actions; this has both an immediate and a lasting effect on the play experience. Yee (2006) has extensively studied what motivates players' actions in on-line games. Commenting on users playing the game, geocachers are talking about "their own world" and "experience places," which represents more than passive participation in geocaching. (Newman 2002) This dissertation examines the nature of the experience when playing Geocaching, and seeks to understand the player's interactions outside Geocaching, such as in the education and tourism contexts. The realization is that the experience is considered to be a type of Geocaching because it is also related to education and tourism contexts, and it is essential for successful games to be examined in digital culture. The player experience means experiential and relational influence, "online" interactions (fully participatory engagement, interaction), and "off-line" mode (users cannot affect the co-experience), as the before has a present of the complex and even simultaneous connections between the players. This doctoral dissertation also presents an analysis of the experience in the context of a diverse game world, in which experience develops over several occasions among the different players. This experience can be equated with the presence of a wide range of players in off-line mode. (Newman 2002)

Yee (2006) divides the motivation to play into three main categories, as follows: *achievement* (functional role), *social* (the role of social context), and *immersion* (in the fictional role, character). Gamers, who are interested in *achievement* enjoy the experience of competing with other players. They like to experience the power of beating or dominating other players (Yee 2005). Players who are motivated by the *social* aspect of the game experience are focused on socializing, relationships, and teamwork. Socializing players enjoy meeting and getting to know other players. The game world offers them casual and pleasant entertainment (Yee 2005). The possibility of co-experiencing and co-creating the game through social interaction offers players an element that supports the occurrence of meaningful experiences (Battarbee 2003; Ihamäki 2013). Through social interaction, players can transform social relationships with gameplay (Salen and Zimmerman 2004).

All in all, the player can enrich the experience of playing a role when the mechanical tasks are complemented with a social frame for behavior. *Immersion* as motivation for play can be very important in experiencing a role. Players who are motivated by discovery enjoy exploring the world and discovering locations, quests, or rare artefacts (Yee 2005). Geocaching players present places and caches to other players in the real world, and players can co-experience caches together, or players who want to find the same cache can follow geocachers' experiences to geocache their own website via the Internet. To find caches in the real world, geocachers become immersed in exploring the places through other player's eyes to find the cache location. Another form of experiencing the character role is through customization. Players choose to favor this subcomponent of the character's unique style and appearance (Yee 2005). Immersing themselves in the personality of the player character and interacting through that personality becomes a means to change and deepen the nature of experiencing pervasive games (Lankoski, 2004).

The player's perspective on the process of game design is crucial to improving the game experience and the understanding of players, and eventually makes up the player's desires and expectations (Sweetser and Johnson 2004). In this thesis, the users consist of experienced geocachers, where the goal is to identify the key aspects of the UX of a treasure hunt game. On the other hand, this dissertation describes the experiences of new players who do not have previous familiarity with treasure hunt games. Player experience is defined in this doctoral dissertation to be an enjoyable experience and playing Geocaching the player feel the game is meaningful to play and users has participatory engagement in the pervasive treasure hunt games to tourism and education context. Digital games are the most common form of entertainment, where the aim is to engage the players in the game. Game designers and researchers internalize a number of strategies and tactics to engage in the activities of players' "gameplay" (Dickey 2005; P5).

2.1.3 Social Experience

The social experience of playing in multiplayer environments brings another level of experiencing within the reach of digital games. In addition, social issues are one of the reasons that successful multi-player games relate to human behavior. In games, one person does not play the same way as another. Every experience is unique, and the result is based on the player's skill and creativity (Weisman 1998). Sharing one's play experience clearly adds something to the overall feeling. The shared experience of the players through a selected theoretical framework is used to reveal some elements that affect the experiences. These elements form a basis for understanding how social interaction and team play affect the experiences of the players. Tarsanen and Kylänen (2005, 137) present the experience pyramid. The Experience pyramid includes six elements for evaluating the experience product of digital games. These elements form a solid basis for the experience phenomenon, and are as follows: individuality, authenticity, story, multisensory perception, and contrast and interaction. As the player progresses through levels of motivational, physical, intellectual, emotional, and mental experiencing and through processes of interest, sensing, learning, experiencing, and change, he or she gains a meaningful experience (Tarsanen and Kylänen 2005, 137–144). The success of multiplayer games seems to indicate that players want to share their experiences with others like in Geocaching. Explanations of this success can be found in the social

nature of humans in general. It has been argued that almost all of the activity around a person is enjoyable (Csikszentmihalayi 1991, 164). Through history, games have been enjoyed in groups of players who choose to share the exceptional situations of the game together (Huizinga 1955, 12). According to Friedl (2003), the players enjoy the feeling of togetherness.

As mentioned above, social experience in general is difficult to define. When a social context is added to the game, the process of experiencing shifts towards an even more complicated area. While experience is an individual reaction, it can also be constructed through social interaction. The players in a multiplayer game create the playing experience together; they "co-experience" the situation (Batarbee 2003, 730). Social norms affect how people behave (Elster 1999), and thus, social situations have a great influence on the shared experience. The individual experience of a participant is influenced by the presence of others and the co-experience is the shared interpretation of the individual experiences (Forlizzi and Battarbee 2004, 263). Sharing the experiences and constructing a shared experience adds a feeling of "realism" and a more meaningful level to experiencing the game. The experience of playing in a group forms as a combination of the group dynamics, the success of communication, and the success of the goal set within the gameplay. In the experience pyramid, the co-experiencing process of a group of players can change the process of experiencing. For example, a player can guide another player through a physical level to an intellectual one. Different tactics and strategies on how to do well in the game can be shared between players, and the emotional level can be reached more quickly and easily. Successful social experiences and working dynamics of the group can also lead to emotional experiences beyond the actual goals of the game. While learning how to play the game with the help of others, there is an added area in the playing itself through the shared experience. The experience pyramid presents interaction with others as one area needed in the product as a building block for an experience. When something is experienced together as a part of a collective, there is a feeling of general acceptance and appreciation concerning the action (Tarssanen and Kylänen 2005, 144). This strengthens the emotional impact of social interaction. However, players' role in the participation in the co-experience is a key factor, as well as the strength of the emotional feed.

Social participation is created through the actual performance of each player's internal goals into meanings. The opinions and expectations of other players play a big part in the overall experience (Csikszentmihalayi 1991, 167–168). The pressure of doing well in the gaming community is higher, like creativity in a community. This can be seen, for example, through increased interplayer interaction that is both meaningful and focused on the task (Manninen 2003, 303). Social action-adventure games such as Geocaching have some caches where a group of players must solve a set of problems in order to find the geocache. This means that the communicational skills and supportive attitude within the group play a significant part in achieving positive social experiences. Geocaching embodies capacities such as know-how and dispositions and has materially mediated arrays of user activities, which are centrally organized around shared experiences and practical understandings. Social experience defined in this doctoral dissertation that participants of this case studies experienced together as a part of a collective experiences there is a feeling of general acceptance and appreciation concerning the action of Geocaching. In this dissertation has presenting users social experiences from cases studies, for example searching geocaches together, creating geocache multi-cache together, or users participating and co-

experiences Geocaching events. In the other hand social experience can define in this doctoral dissertation, that users co-experience in Geocaching events by others action or user connected via Internet and shared experiences in Geocaching community.

2.1.4 Creative Experience

Kairos Future Ltd. (2004) has developed the term “generation C” (content providers) to describe the values of this generation, which are individualism; the freedom to make one’s own choices; creative experiences, which are valued at more than materialism; and a strong need to be available for the new media (Fernström 2005). Creativity does not exist only for itself, but also to develop the difference between economic spin-offs and the authenticity of the range (Zukin 2010). Chua and Iyengar (2008) show they research, that gives people the flexibility to offer a variety of resources in the early stages of creativity, has been found useful in certain situations.

Creative experience involves active rather than passive learning (Richards 2005, 17–18). The activity of the creative experience allows local knowledge, expertise, tradition, and uniqueness in locations to be exploited (Binkhorst 2005; Richards and Wilson 2006). The creative economy has been learning by participating in arts and crafts, design, health education, languages, sports, or geocaching (Richards 2005; P4). Cloke (2007) presents the inherent creativity of communities and individuals to enable them to co-create new short-lived states. Creative experience may include new types of interaction between the tourist and the local community. Creative experience is activity where participation creates special experiences; for example, in geocaching, users create experiences for other users, and everyone experiences geocaching in individual ways. Geocaching creativity is one of the goals for players, because they are recognized in the geocaching community as having created something special, and at the same time, they create something unique in a geocaching adventure. The Geocaching game changes every time, because players create new geocaches and want to be creative and be recognized for the special geocaches. In this dissertation is defined creative experience in geocaching, which means geocaching has creative do-it-yourself elements in the game; users sift their identity form passive users of high technologies to active creators of their own experience.

2.1.5 Emotional Experience

Emotions have been described as separate and synchronized periods in which changes occur in response to people's evaluation of the external and internal situation, as well as the personal feeling resulting from meaning (Scherer 2005). These periods were typically event-focused, adaptable, short-lasting, of variable intensity, and have an impact on human behavior. Previous research on UX has highlighted the importance of emotions indicating that they are at the heart of experience (Forlizzi and Battarbee 2004; Hassenzahl 2010). It can be understood that without emotional engagement, the experience will lack unity and ultimately fail as such (McCarthy and Wright 2004). Emotions include motivation and cognitive processes, and contribute to experiences in every moment of our lives (Hektner et al. 2007). All experiences have some kind of feeling regulated by

human emotion (Varela et al. 1991). Desmet and Hekkert (2007) consider the importance of emotions in UX by including them in their product experience framework. Emotional experiences are used in similar terms as pleasure or positive experiences. Positive emotions are important in daily life, but there is little knowledge about this. Seligman and Csikszentmihalyi (2000) consider positive psychology and argue that although psychology has elucidated a range of negative human characteristics, it still needs to address the issue of what makes life worth living. Positive emotions are central to human nature, promote quality of life, and improve mental and physical well-being, as well as a healthy lifestyle (Ortony et al. 1988). In addition, many positive emotions broaden users' momentary thought-action repertoire (Fredrickson 1998). In the field of product and service design, as in psychology, it has been identified that positive emotions have been underexplored. For example, enchantment, inspiration, and kindness have barely been studied, although they are relevant to design practice. This lack of knowledge increases the difficulty of eliciting positive emotions through products and services, which explains why there are few reported strategies to design them. New knowledge about positive emotions can developed with a view to designing positive experiences (Laurens et al. 2012). To set the foundation for researching the variety of positive emotions experienced in human-product interaction, Desmet (2012) identifies 25 design-relevant positive emotions, suggesting six sources that explain how these emotions are triggered by products and services, specifically, object, meaning, interaction, activity, self, and other.

This dissertation represents an important step towards a better understanding of pleasant and positive user experience in geocaching and treasure hunt games its applications to tourism and education. One of the main reasons for game design is to maximize players' emotional experience, specifically their enjoyable gaming experience. Emotional experience is defined in this dissertation as substantially physiological, affective, and cognitive according to measurements, and at its core, it is an entertainment medium (Vorderer et al. 2004). This doctoral dissertation represents the case studies, which Geocaching gives emotional experiences, which consist of users experience, cognitive and emotional point of view.

2.1.6 Temporal Experience

Paxinos and Watson (1998) contend that human activities limit to the time of the temporality behaviorism: A stimulus (i.e., cause) precedes a response (i.e., effect). In other words, the past determines the future. This temporal framework excludes what these researchers view as essential facets of human nature, namely choice, novelty, emergence, and improvisation. In Geocaching temporal framework essential facet of geocacher nature is to be explorer, who namely choice to find new geocache place and create novelty geocaches with other players. Some of novelty ideas emergence to be social interaction with other players and co-experience for Geocaching community other players' experiences. Geocacher's could also improvise and share their stories of geocaching trips.

Giddens (1979) describes the incorporation of temporality into the understanding of human agency, and contends that agent conduct is based on choice: "It is a necessary feature of action that, at any point in time, the agent could have acted otherwise" (Giddens 1979, 54-56). Similarly, Emirbayer and Mische (1998) assert that the dimension of social action can only be captured in its

full complexity if it is analytically situated within the flow of time. They conceive of directing agency toward the modification of one's own temporal experience. This experience reflects the density of information processing occasioned by one's immediate situation (Flaherty 2003). In addition, Csikszentmihalayi (1991) describes the flow as temporal, starting with the first use; its eventual success depends on its continual long-term use. Cskiszentmihalayi (1991) also argues that enjoyment, as realized in the flow state, is an autotelic or self-motivating experience, as characterized below.

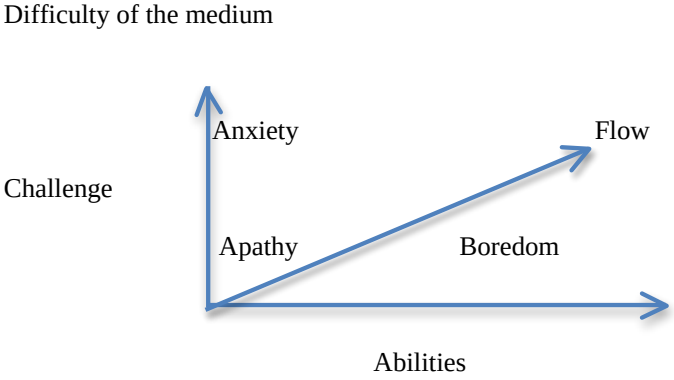

Figure 1. Model of flow (adapted from Cskiszentmihalayi 1991).

Approval must be defined in a way that is open to the present moment to experience something (temporal experience; Roemer and Orsillo 2002). It is associated with the conscious to deploy a variety of experiences, and the active process allows the flow of thoughts, feelings, and experiences (Hayes, Strosahl, and Wilson 1999). This is an active process in which the user chooses to offer the game attitude no matter what happens—it represents conscious openness. Temporal experience can be conceptualized as a process related to open and active participation in the creation of the gaming experience. In this thesis, temporal experience reflects the density of information of processing occasioned by one's immediate situation of Geocaching activity. Geocaching user immediate situation could be that he or she find too much muggles in front of geocache and can't write log book. Muggles is term of users, who don't know what geocaching is. (Suarez, Dudley 2012) Temporal Experience is defined in this dissertation it is linked to the time.

2.1.7 Educational Experience

Educational experience can be understood as the motivation behind an experience, and the user can learn about one's own self-concept or self-esteem; this is a strong motivator to acquire new knowledge (Baird and Fisher 2005). In Geocaching, users are motivated to learn about each other when they build in-game content—for example, in the case of extreme geocaching, experiences that users want to share with other Geocaching communities and when they challenge others to give them more extreme geocaches than they have in the past. Educational experience can be viewed from collaborative learning perspective, where a group of people learn with others and solve problems together. Engagement, defined as user interaction, peer-to-peer collaboration, and active

learning (Chen et al. 2008), is positively related to the quality of the educational experience. Engaging education is the process by which users actively participate in their learning. Engaging education has been developed by Jones (1999), who showed that engaging collaborative learning, which has been achieved by some strategies and emerging technology, can be nurtured by orchestrating diverse activities and resources. From a cognitive perspective, knowledge resides in users' minds, while in the socio-cultural approach, the concept of collective knowledge is central, as in a geocaching community.

Educational experience in this dissertation, which focuses on the influences of pervasive adventure games on users' learning, revealed that playing Geocaching may have a positive impact on user learning, because games have a huge influence in terms of constructing a connection between virtual life and real life and encouraging critical thinking (Lim, Nonis, and Hedberg 2006; Mitchell and Savill-Smith 2004; Turvey 2006). Roussou (2004) states that playing digital games is one of the favorite activities of young people and geocachers, so an environment that includes elements such as fun and entertainment might have a positive impact on their learning. In addition, digital games have several motivational and pleasure elements, and young people and geocachers prefer playing Geocaching games. Therefore, according to Squire (2003), educators can use motivational elements of Geocaching games while designing and developing interactive game-like learning environments. Students mostly prefer interacting during gameplay states; moreover, the interaction patterns of students might lead to some motivational outcomes. Among them, students will engage in optimal educational experiences, which have a direct relationship with their motivation. Individuals' educational experiences might be influenced by playing Geocaching that encourage them to interact with one another. I have seen the balance between an individual's skills and difficulties of geocaching exercises. This suggests that educational experience depends on this balance, and that if a balance does not exist between the individual's skills and the Geocaching exercises, educational experiences cannot occur. Csikszentmihalyi (1991) describes flow experience as a situation of complete engagement in an activity, like searching geocaches. Finneran and Zhang (2005) state that it represents a state of consciousness where users are so engaged in an activity that they exhibit high-level performance without being aware of their environment.

According to Csikszentmihalyi (1993), activities that create more flow than others are those that 1) have concrete goals with manageable rules (searching for geocaches), 2) make it possible to act according to players' capabilities (creating exercises in the real environment, finding exercises in the geocache), 3) provide clear information on how activity participants are doing (action in geocaching community), and 4) make concentration possible (concentrating on geocaching exercises and finishing them successfully). In order to facilitate educational experiences, pervasive treasure hunt games should have certain characteristics. Sweetser and Wyeth (2005) state that users perceived that skills are very important and they should match the challenge supported by the game. Both need to be balanced in order to facilitate flow during gameplay. The researchers claim that challenge is an important aspect of pervasive treasure hunt games; these should provide challenges so that the player's skill level can be easily matched by changing the level of difficulty, which should remain appropriate. Besides, games should provide clear goals and appropriate feedback to students in order to facilitate educational experience.

Clements (1998) states that students prefer working with their friends to being alone while carrying out given tasks. Thus, the game should provide social interaction and social experience for players (Sweetser and Wyeth 2005). Characteristics of pervasive treasure hunt games and interaction among students are factors in their motivation to engage in Geocaching learning activities. In order to benefit from the potential of treasure hunt games to enhance students' learning capabilities, the motivational aspects of an interactive social game environment should be taken into account before its application using the treasure hunt game as a method.

Educational experience is characterized in this doctoral dissertation as an individual learning experience, and at the same time as a collaborative learning experience where users build knowledge together in a geocaching community, classroom, or as a creative tourism experience. The best user education experiences have to do with sharing practices by learning with others, and creating designs that reflect their own learning practice. The learning designs are always reflected in activities, and users may have different learning resources when they perform different activities in a Geocaching game. Sampson et al. (2011) propose that learning design orchestrates different activities and resources. Moreover, Clegg et al. (2013) have used social media technologies to support more collaborative interactions with students; these researchers highlight facilitating communication and underscoring the importance of factoring in the learning context, which they have designed, as well as implementation of computer-supported collaborative learning technology.

2.1.8 Flow Experience

The term *flow* is used to describe the engagement starts an activity, which refers to the optimal experience (Csikzentmihalayi 1991). For this experience, the user is in a psychological state in which he or she carries out purposeful activity, and nothing else seems to matter. As part of the HCI context, emotional levels are called the flow experience, which is usually described as fun, playful, and pleasurable (Pace 2004). Czikszentmihalayi (1991) emphasizes balance between the individual's skills and the difficulty of the tasks to be carried out. Positive experience can be seen as a process in which the outcome sometimes seems to be more pleasant and self-rewarding. Csikszentmihalay describes this experience as someone's *"flowing from one moment to the next, in which he is in control of his actions, and in which there is a little distinction between self and environment, between stimulus and response, between past, present, and future"* (Csikszentmihalyi 1991, 34). This theory of flow experience depends on such a balance, and between past, present and future are not depending on the individual's skills and tasks, so that the flow experience cannot be realized. Finneran and Zhang (2005) have found that the experience represents the flow of consciousness and awareness of the activities in which people are absorbed, where in they show a high-performance, environment-conscious existence. However, it is important that the flow experience is achieved regardless of the available skills and tasks involved in the challenges (Csikszentmihalyi 1991). Sweetser and Wyeth's (2005) present GameFlow model that consists of core elements, which are: concentration, challenge, skills, control, clear goals, feedback, immersion, and sociality. Kiili et al. (2012) present a flow framework in which elements of flow can be divided into three groups, namely flow antecedents, flow state and flow consequences (Figure 2).

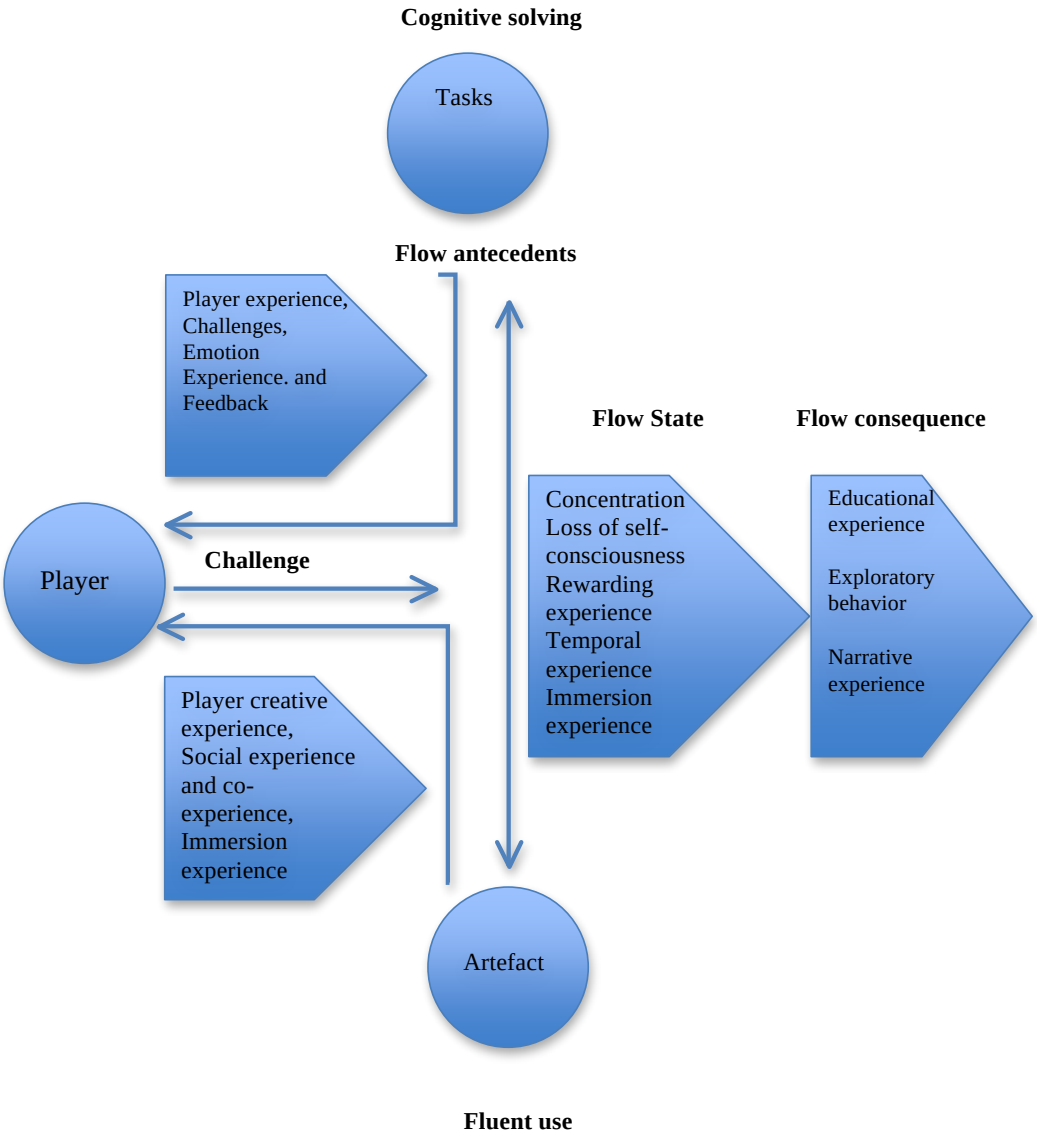

Figure 2. Flow framework of the pervasive adventure game design (adapted from Kiili et al. 2012).

The flow antecedents: The flow is the formation of the factors that affect the flow of state and should be taken into account in designing the game. Agarwal and Karahanna (2000) noted that cognitive absorption (CA) is the state of flow, which depends on user behavior with using software. Specially, they described five dimensions of CA the context of software (temporal dissociation, focused immersion, enjoyment, control, and curiosity) and contended that personal innovativeness and experiences can predict CA. Flow experience has related to intention to use a system, while an individual engaged in an activity that supported flow states. As in this (Figure 2) describes flow states, which consists: concentration, loss of self-consciousness, rewarding experience, temporal experience and immersion experience. Most of Figure 2 is in line with the flow measurements of

the original (Csikszenthihalayi 1975). However, the player's creative experience is a new one, which is based on case studies (P3). A player's creative experience is based on tourism literature for creative tourism, which means that tourists are involved with making their own experiences of destinations. As in Geocaching, users create an example of a mystery cache, and the players need to solve the problem before they find its location. In Case study three present a good example is the following comment by geocacher Saviranta: *"It requires skill to do caches, very good masked urban caches are the bests and also it's great to solve difficult mystery caches."* (Geocacher Saviranta) It is important in the context of creative tourism to provide an environment in which it is possible to experience and learn, but the change itself is also important (Pine and Gilmore 1999). If a tourist is able to convert the creative experience, then their experience will be authentic and different from the previous one, even if it involves a familiar environment (P3). Flow is preceded by the player's experience and the challenge is to create balance when the player is focused on the educational experience and moves forward with the narrative experience (Cskszenthihalayi 1975). Kiili et al. (2012) discuss players' need to have clear goals in flow antecedents. It is good to have clear major objectives (such as player experience and challenges) at the beginning of the game. In addition to the main objectives, sub-goals such as emotional experience could provide new tensions in the game in order to produce successful experiences. In addition, it would be good to involve the targets in the training experience and the experience of the narrative in the game. For example, the game could teach the game mechanics, as well as the narrative-driven experience itself would be present.

The main purpose is to give the player feedback so that he or she can progress toward his or her goals, which can be monitored through the co-experience and achieved according to the level of feedback. However, the game experience is personal, so feedback designs are also transferred in the personal direction (Kiili et al. 2012). Dunwell et al. (2012) have proposed a new feedback model that includes the type, content, format, and frequency of feedback (Dunwell et al. 2012).

The social experience and co-experience are included in the flow framework, because flow is part of the Geocaching game activities, which have social experiences, as presented in the case studies (P1). It may be more difficult for students to set goals that are consistent with their skills. The flow channel can involve using instructions, providing the ability to solve problems together (Kiili et al. 2012). Immersion experience can be defined as a feeling of taking over another reality (Ermi and Mäyrä 2005b). Ermi and Mäyrä (2005b) divide the experience of immersion into three components, namely sensory, challenge-based, and imaginative immersion. Immersion of the senses is associated with the audiovisual implementation of the game. On the other hand, the challenge-based levels deepen the interaction between the players. This is equivalent to Csikszentmihalay's (1991) notion that challenge and skill, dimension, and the assumption that emotions are immersed in the experience are the most effective when a player can achieve a balance between challenge and ability. The image of the embedding can be externally similar, but flow experience traps the player's sense of time. Flow experience directs all attention to certain objectives, while the immersion experience means a physical or virtual experience itself (Kiili et al. 2012).

The flow state is described as a state of concentration, which leads to time distortion, rewarding experience, and loss of self-consciousness. With this loss of self-consciousness, the player becomes totally focused on the activity and is able to forget all unpleasant things (Kiili 2005). Flow experience activities require complete concentration and attention to the task at hand; therefore, the cognitive resources are not used in the player's attention to no avail. Rewarding experiences require action, which corresponds to the expectations and makes the experience simply interesting and fun, without temporal attention.

The flow consequences mean that the immersion space is considered to be desirable. However, a more reduced flow of experience is an important consideration, taking into account the design of the game. With educational experience, the main player matures and his or her experience will grow and increase, which will be a resource for learning. Users are motivated to learn from the experiences of others; for example, geocachers who are interested in extreme geocaching want to share an edgy and hard-to-reach Geocaching experience with others. Motivation to learn and experience has grown, increasing the possibility of co-creating and experiencing things and learning new things with others, such as through YouTube videos in Geocaching. Motivation to learn from experience is a result of new information, the creation of which extends to the social experiences and the value to the community (Ihamäki 2013).

The narrative experience can be transferred to common sense thinking when we need to challenge our thinking during the interaction, which is frozen by our attitudes and beliefs. For example, Geocaching CITO (Catch in Trash Out) is an event campaigning for green living and cleanliness. Users must re-evaluate their experiences and their current attitude and seek to change their behavior (Forlizzi and Ford 2000; Ihamäki 2013).

With modified behavior, it is important to note that the flow experience becomes visible when the player's body and mind are stretched to their limits through voluntary action. First, betrayal of trust increases potential losses in individual transactions. Second, the norm of reciprocity thrives with the activities of a social network. Third, its existence supports communication and better information flow. Finally, past successes involving cooperation become stored in networks, which in turn boosts the members' faith in their resources of operation (Ilmonen 2000, 23). Geocaching offers experiences, moments of success, and the joy of exercise (Ihamäki 2006). In this doctoral dissertation characteristic flow experience is psychological state which user been so involved play to Geocaching and nothing else seems to matter.

2.1.9 Narrative Experience

Researchers have studied a large variety of interactive narrative experiences, such as new third-person narration and interaction models (Aylett et al. 2005; Pizzi and Cavazza 2007). Forlizzi and Ford (2000) discuss the experience of a story in terms of the idea of discussion (Schank 1998). Stories can be summarized as narratives and remembered experiences, and they can be delivered to different situations for specific audiences. Narrative experience plays an important role in these multidimensional events such as adventure games. As the experience of the story is, of course, communicative, it is relevant to take into account and observe user experience studies in various disciplines and game designs.

A unique experience is composed of an infinite number of small experiences that are related to each other, as well as to users and products. For example, the Geocaching experience on a mountain, it might be made up of smaller experiences such as climbing, ascending, and the interaction between similar sites, in addition to finding a geocache and the interaction with the geocachers involved.

As designers strive to produce experience, we can only design the situations in which users can interact, which then becomes the opposite, a prophesy of the results that were produced (Forlizzi and Ford 2000). As the story offers players the opportunity to find a geocache place, players commit to searching for it. If one happens to engage in a geocaching game in a foreign context, the geocache can be experienced in another way than the original geocacher intended. Since the geocache location is unknown, the seeker will find it through ordinary life experiences. On the other hand, hiding the geocache relies on their own perception of the narrative to create an experience through the geocache. The narrative is seen as an interaction between the physical location and the object (Ihamäki 2013). Stories include narratives that serve as schematic structures. According to Mandler (1984, 22), stories exist in the background, bottom, or part of a structure and remain relatively unchanged regardless of content or genre.

One of the basic human means of experiencing the world is through stories. The quality of a story derives both from life and processes of reflection. Within stories, narratives serve to guide and provide a structure for a listener or reader. With regard to games, to engage in a narrative as a player is to be drawn into participating with a story (Clandinin, Connelly 1989). Narrative experiences challenge our thinking in terms of our perceptions, attitudes, and beliefs as players during interaction. Such experiences in turn force us to review and potentially change our current attitudes and behaviors, as well as to absorb new knowledge. When we as players engage with narratives, we add to them our own levels of meaning. Furthermore, such experiences can alter personal understandings as they relate to one's own experiences. Stories are composed of narratives, and we as players wish to share our own experiences and narratives as part of stories. These ideas are especially important for game designers in creating game stories that can be expanded by players (Forlizzi and Ford 2000). In this thesis, narrative experience is understood to occur when users are forced to challenge their own thinking in terms of perceptions, attitudes, and beliefs when using geocaching applications.

2.2 Summary

In summary, an experience extends beyond the users' role to make them active participants in the creation of their own experience. The emotional mode allows the user to be more involved in creation of his or her own experience (which varies from immersion to absorption). UX has many definitions, but it consists of a dynamic relationship between the user and the device in the application used in the environment. The UX can be described as an interaction between different temporal lengths, different levels, and types of experiential results. In the future, it will represent more than just a definition of what it is or what it is not, because it is complex; thus is being developed as a method and a process that supports the planning of a successful UX (Olsson 2012, 12). Roto et al. (2011) have examined UX theories and framework definitions and placed them into

three main categories. First, *user experience as a phenomenon* relates to what a user's experience is and what it is not, as well as the different types of user experience, including their causes and consequences. Second, *present user experience as a field study* includes studying, for example, what and how user experiences are formed, as well as what users expect to experience. Field studies of user experiences are done in order to design systems that enable particular user experiences. Third, *user experience as a practice* is concerned with, for example, user experience as part of the design process, such as building a prototype to demonstrate and communicate a desired user experience. User experience in practice also includes such practices as evaluating UX and delivering designs aimed at enabling a certain user experience (Roto et al. 2011).

For the player experience, the main goal is to have pleasurable experiences and engage the player in the game. Player experience can be seen as an element in this UX that engages the user's attention and involves the user in an activity or creative enjoyment of digital services. Users can reach a flow experience, where they attain a psychological state in which they are so involved with the goal-driven activity that nothing else seems to matter. This doctoral dissertation is overview of user experiences, which is dynamic and multifaceted and the aims is to create users positive experiences for playing Geocaching game.

3 User-Centered Design and Pervasive Game Design

This chapter describes the phenomena of both UCD and pervasive game design from several perspectives. The ultimate goal is to define UCD and game design terminology and models. Finally, the goal is to make a summary of UX and UCD models that support this dissertation.

3.1 Definition of User-Centered Design

Norman and Draper (1986) can be considered pioneers of UCD, identifying ground-breaking factors. They emphasize that it is important to know the users. The purpose of UCD is to serve the user, not to use a specific technology. The needs of the user should dominate the design of the game inter-face, and the needs of the game should dominate the design of the rest of the system (Norman 1986, 61). The lack of a shared understanding of meaning of UCD has been demonstrated by Karat (1996), who stated that UCD is an iterative process whose goal is the development of usable systems, as well as the involvement of potential users of the design. UCD gathers knowledge about how to develop usable and pleasurable pervasive games. It captures a commitment to system usability—where users must be involved in the design process—while leaving open how this will accomplished (Karat 1996).

Gulliksen and Göransson (2001) define UCD principles as follows: 1) the work practices of the users control the development; 2) active user participation throughout the project; 3) early prototyping to evaluate and develop design solutions and a shared understanding of users' needs; 4) continuous iteration of design solutions; 5) multidisciplinary design teams; and 6) integrated design. The results have provided valuable insights into the UCD perspective, such as the case study shows (P5). In this dissertation, a number of unique features have been found in the selected cases, with a comprehensive assessment of the effects of treasure hunts in the education and tourism contexts. UCD success, processes, and a comprehensive assessment of the strengths and weaknesses of the method can now be involved in product development. UCD gives the opportunity to explore its benefits and to determine the empirical material attributes related to the efficiency of the implemented dissertation. According to Keinonen (2008), *"User-centred design is a broad umbrella covering approaches such as traditional human factors and ergonomics, participatory design, human-centred design, usability measurements and inspections and design for user experience."* UCD is useful for the UX and customer satisfaction research; in addition, we need to understand the users and include them in the development process, which increases the quality of design. Therefore, the requirements of the scheme and the intensity of development work (for example, to avoid expensive changes at a later stage of development; Damodaran 1996; Kujala 2002). UCD also means human-centered design, representing a cyclic process that includes an active user adjustment of all of the development activities and the iterative design process, as well as a multidisciplinary approach (ISO 13407 1999).

3.2 Definition of Pervasive Game Design

Magerkurt, Engelke, and Memisoglu (2004) state that pervasive games take place in streets, the countryside, schoolyards, and so on, and open the closed system of digital games by including elements of real life within the gameplay. According to Jegers (2007), pervasive games redefine what players consider "game flow" and pleasurable experience. Geocaching as a pervasive game has spread all over the world, from Tenerife at the top of a volcano to the middle of Helsinki Senate Square. In geocaching, the player engages in flow experiences, for example, searching for treasure and trying to figure out where another player has hidden the geocache. Pervasive games are based on urban representations in certain places, as users create geocaches for their own purposes. Saha and Mukherjee (2003) see mobile computing as a subset of pervasive computing (Saha and Mukherjee 2003), while Roth argues for the opposite (Roth 2002). *Pervasive* means "omnipresent," and pervasive computing is a "smart" or "active" space, contextual awareness, and the way users use devices to interact with the environment. Pervasive computing has three core states: First, it concerns the way users view mobile computing devices, and use them within their environments to perform tasks. Second, it concerns the way applications are created and deployed to such tasks. Third, it concerns the environment and how it is enhanced through the ubiquity of new information and functionality (Benavar et al. 2000).

Pervasive games could potentially preserve some of the valuable elements of traditional outdoor games. Geocaching has the chance to be played a children's outdoor game of hide and seek in the backyard, but using smartphones to caches all over the world. Player experience has changed in pervasive games, for example, in four dimensions related to emotional attachment to the game. The dimensions of pervasive games are *physical experience*, *mental experience, social experience*, and *immersion in the game*. The physical dimension describes experiences by players when interacting with concrete objects and real persons in the physical environment. Physical experience can be realized best in physical reality, whereas in virtual reality, there are almost no possibilities to bring concrete user interfaces to the players (Cheok et al. 2002; Magerkurt, Engelke, and Memisoglu 2004). The second dimension, mental experience, is stimulated by mental or intellectual challenges such as puzzles. In the mental dimension, challenges and experiences regarding the mind and brain are possible in all realities. In virtual reality, however there are more powerful concepts possible. The third dimension is the social dimension, which reflects interactions with other players. This is an important aspect and has attracted a lot of attention, since computer games have been criticized for diminishing players' social skills (Cheok et al. 2002; Magerkurt et al. 2004). The fourth dimension is the immersive dimension, which describes how players can be immersed in a game. Virtual reality games, in contrast to traditional games in the physical world, can result in greater immersion (Cheok et al. 2002; Magerkurt et al. 2004). Still, pervasive games are situated and played in the real environment, in much the same way as traditional games. On the other hand, games like geocaching enhance and leverage the overall immersive gaming experience.

Jennett et al. (2008) studied immersion in games and present five experiential subcomponents of the UX in games. These subcomponents consist of cognitive involvement (curiosity and interest), real-world dissociation (attention, temporal dissociation), challenge, emotional involvement (empathy, enjoyment), and control (ease of control, interacting with the

game). Montola (2005) defines pervasive games as games that have one or more features that expand the contractual magic circle of play socially, spatially, or temporally. The metaphorical magic circle of play is a voluntary, contractual structure that is limited in time and space (Montola 2005). Pervasive games consciously exploit the ambiguity of expansion beyond the basic boundaries. Any action could be a game action, and any sensory observation by any participant could be seen as part of the game.

Björk et al. (2002) define a pervasive game as a game that is always present and available to the players. Pervasive games can be location-sensitive and use several different media to convey the game experience. Kovisto and Wenninger (2005) identified six categories of pervasive features for current Massively Multi-player Online Role-Playing Games (MMORPG) and supported they findings with six focus groups with players and developers. Koivisto and Wenninger (2005) present the features of MMORPG as follows: communication access, event notifications, asynchronous gameplay, synchronous player-to-player interaction, passive participation, and parallel reality. The communication access category is used mostly for mobile phone communication and socialization features. Meanwhile, the event notification category allows the game or other players to contact the player anywhere. Game features can partly be managed asynchronously. Examples of these kinds of tasks include crafting, adding new items for sale in one's in-game shop, or offline character development. Synchronous player-to-player interaction in the pervasive game world means that players who use different platforms for playing the same game need to be equal. Passive participation means that the player does not need to actively play the game, but can instead observe the game world or influence the game by voting or rating with his or her mobile device. Parallel reality means that the game takes place in two different worlds—the real and the virtual (Koivisto and Wenninger 2005).

As mentioned above, pervasive game design can be seen through the four dimensions, which are physical experience, challenges (mental experience), social experience, and immersion experience. In this thesis, geocaching is pervasive game and these dimensions are visible in geocaching. Player get physical experience of Geocaching game, for example in case study have one geocachers who has find already 3000 geocache, which mean that he/she has get 3000 physical experiences (P3). Geocaching give challenges for player by finding geocaches difficult places or mystery cache, which need to solve problems before find geocache. Geocaching give social experience for example meet geocacher's local Geocaching events. Geocaching give immersion experiences for example when user is middle of pipe and try finding geocache, without even thinking anything else or even the time spent on not mean to anything.

3.2.1 Gamification

The term *gamification* was original coined in the digital media industry. The first documented use of the term was in 2008 (Paharia 2010), but it only became more common in 2010. New terms followed from this concept, such as *productivity games* (McDonald et al. 2008), *funware* (Zichermann 2008 mentioned by Takahashi 2008), *behavioral games* (Dignan 2011), *game layer* (Priebatsch 2011), or *applied gaming* (Natronbaxter.com). Yet, gamification is likely to the most established term. Gamification refers to the planning of services, and it is designed to provide a

game-like experience to the users, and in general, to affect users' behavior (Huotari and Hamari 2011). Gamification is different from the other parallel terms in the following ways:

1) Gamification involves the attempt to create an experience that resembles the game, where players have a sense of flow and autonomy, and maintain rather than provide direct hedonistic experiences such as audiovisual content or economic privileges, which are seen as a loyalty to marketing;

2) It attempts to influence motivation rather than the attitude and behavior of technologies (Fogg 2002); and

3) It refers to the increased "gamefulness" of existing systems or features to be newly built into the game to make it a "serious games." Despite this, "gamification" is also very competitive, in particular within the game, both in the industry and the game research community.

Gamification is an informal, general term for digital game elements in non-gaming contexts intended to improve user experiences and in turn user commitment to non-game services and applications. Some researchers consider any game-related application to include gamification, including serious games, playful interaction, and game-based technologies. A serious game is a game designed for a primary purpose other than pure entertainment. Serious game is a term used to describe the development of games that are specially designed to affect a player in some manner (McCallum 2012). In serious games, gamification involves the use of game elements for purposes other than their conventional use as part of an entertainment game (Deterding et al. 2011). Gamification utilizes game elements in non-gaming contexts to improve user experience and engagement. The goal of gamification is not to engage chance, which is one area where it differs from a serious game. Gamification seeks to bring elements of, for example, a serious game into a non-gaming context, such as in geocaching. This is why it is difficult to draw a strict boundary between gamification and serious games. The novelty of gamification can be distinguished from playful interaction or playful design, though in practice it can be assumed that gamification often can and will give rise to playful behaviors and mindsets, much as video games encourage switching between different behaviors and mindsets when playing (Barr 2007) There is a certain degree of consensus that playfulness should be considered an attitude or mindset toward a given activity rather than a distinct set of observable behaviors. Researcher Sebastian Deterding defines gamification as the use of game design elements in non-game contexts (Deterding et al. 2011). Gamification commonly involves four components: 1) game, 2) elements, 3) non-game context, and 4) design. Figure 3 offers a definition of gamification.

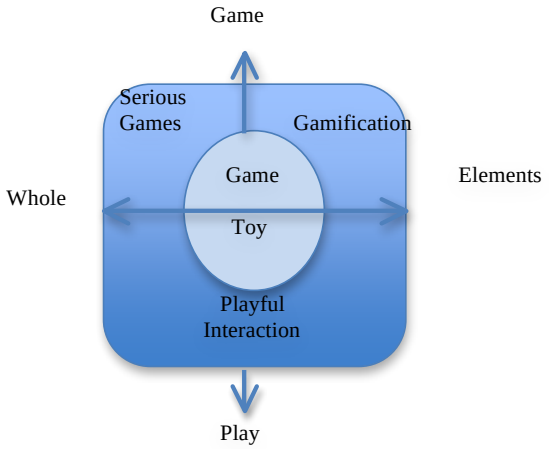

Figure 3. Diefining Gamification, Gamification is the use elements of game in non-game contexts.

Game

Salen and Zimmermann (2004) point out that play includes game and vice versa. In classic game research, Juul (2005) and Salen and Zimmerman (2004) agree that games may be defined by the rules and objectives of the competition or participation in the game. Salen and Zimmerman (2004) describe a game as an activity with some rules followed for an outcome, and define that game as a *"system in which players engage in an artificial conflict, defined by rules that result in a quantifiable outcome."* Geocaching is a game that engages users to continuously to create new geocaches and find those others have created. A geocaching player always receives one point when he or she finds a geocaches; some players compete over how many geocaches they can find. Games can be designed and played for different purposes, including, for example, entertainment, learning, or training.

Juul (2003) game definition consists of six game features: 1) *Rules:* Games are rule-based. 2) *Variable quantifiable outcome*: games have variable, quantifiable outcomes. 3) *Value assigned to possible outcomes*: That the different potential outcomes of the game are assigned different values, some being positive, some being negative. 4) *Player effort*: That the player invest effort in order to influence the outcome (i.e games are challenging). 5) *Player attached to outcome*: That the players are attached to the outcomes of the game in the sense that a player will be the winner and "happy" if positive outcomes happens, and loser and "unhappy" if a negative outcome happens. 6) *Negotiable consequences*: The same game (set of rules) can be played with or without real-life consequences.

Geocaching can be defined according to Juul's definition of a game. While geocaching includes very few rules, if you take something from a geocache, you also need to leave something for other players. Geocachers write their findings in logbooks and make comments on geocaching websites. Geocaching involves *variable quantifiable outcomes* in which users track the number of geocaches they have found. For example, in case study (P3), one geocacher in Finland found 3,000 geocaches in 2012. Geocaching *values* offer players positive experiences. For instance, some geocachers like extreme geocaches that are difficult to reach, whereas other geocachers prefer

mystery geocaches, which require solving a problem to reach, such as a math or historical problem. Geocaching *effort* refers to motivation generated via geocachers working together to create new content. Geocaching.com collects geocaching news from all over the world and includes a forum for the development of applications and different types of caches among web-based communities. Geocaching is not merely a game, but can also be regarded as a technological platform for testing a variety of geocaching applications and solutions (Ihamäki 2012a, 163, Ihamäki 2015b). Geocacher's are *attached to outcomes*. For example, geocachers compete in FTF (First-to-Find) competitions to gain merit in geocaching communities. Geocaching often involves *negotiable consequences*, such as when geocachers run into "geomuggles," or, those who do not know what geocaching is, in real-life situations, who stumble upon geocaches themselves.

Element

Gamified applications use elements of games that do not represent the entire game. Playing the game and understanding of player experience it is mandatory to be able to determine in this doctoral dissertation of geocaching game. To understand user experience of geocaching need to examine within the elements that belong to it, as well as its social meanings. This means that we should identify the technical and social elements of games. Technical and social elements are important in Geocaching games; for example, geocachers organize geocaching events every month all over the world, with the aim of meeting like-minded people wherever they go. Technical innovations have been taken up very quickly in Geocaching games; for example, QR codes have been used in geocache places, and there is a lot of software that supports the geocaching game.

Typically, games can be found outside of the elements that are needed to play them (for example, goals and rules; Juul 2005). One solution is to treat game elements as a set of building blocks or features shared by games rather than a set of necessary conditions for a game. A very strict interpretation of this approach – accepting only elements that are unique or specific to games – would produce an empty that can be found in an game – would be boundless. (Deterding et al. 2011) Deterding et al. (2011) suggest restricting 'gamification' to the description of elements that are characteristic to games – elements that are found in most but not necessarily all games, readily associated with games, and found to play a significant role in gameplay. This is a heuristic definition with much room for debate over what is 'characteristic' for games. As a result, one may ask how to determine the design of the elements and how many elements there are in the game. The gamification elements described above, which are specific to games, still leave much to discuss.

The Non-Game Context

Gamification as a term is the "use of game design elements in non-game contexts" (Deterding et al. 2011, 1). The purpose of gamification more generally has involved to the use of joy and improvement of UX. First, as a term is game it implies that the entire activity will become an engaging experience, when in reality gamification typically uses only the least interesting part of the game (Nicholson 2012). Second, the interpretations may be surrounded by serious games, such that gamification can be used for specific purposes (such as learning). Game ratings also determine the use of the situation or the purpose, which is why gamification is seen as an element that can be used, for example, for education with entertainment purposes, but does not interfere with cognitive

analyses. In this dissertation, the non-game context is tourism and education extended to the Geocaching game. In tourism, businesses have just started to use computer games, while the educational industry already has educational games. However, digital games can be used much more in education than they have been so far, especially in Finland.

Design

Loren Baxter (2011) has stated that persuasive design, or, the use of psychology in design to influence behavior, can benefit user experience design on a new level, which suggests its potential use in gamification design. In HCI, there is a long tradition of using game controllers as input devices for other purposes. The literature on games and 'gamification' describes game design elements at the following five levels of abstraction (Deterding et al. 2011), from concrete to more abstract: 1) interface design patterns (Crumlish and Malone 2009), 2) game design patterns (Björk and Holopainen 2005), 3) game mechanics (Taylor 2009), 4) design principles, heuristics, or 'lenses' (Schaffer 2008), that is, conceptual models of game design units (Brathwaite and Schreiber 2008; Calvillo-Gàmez et al. 2010; Fullerton 2008; Hunicke et al. 2004), and 5) game design methods and design processes (Balman and Flanagan 2010; Fullerton 2008).

In designing a game, 'gamified' applications merely borrow several design elements from games. From the perspective of a designer, what distinguishes 'gamification' from regular entertainment games and serious games is that they are designed to include elements of games, not to be full games themselves. From a user perspective, such systems can however be experienced as 'game proper', gameful, playful, or otherwise, which is what sets these games apart from 'games proper' (Deterding et al. 2011).

To summarize, gamification refers to the use rather than the extension and design of game-based technologies or other game-related practices. Gamification refers to elements of games rather than full-fledged games, and to the characteristics of games rather than their playfulness. Gamification refers in non-game contexts regardless of specific usage intentions, contexts or media of implementation.

3.2.2 Gameplay

Gameplay is the heart of games, and it can be judged from the perspective that there should not be major gameplay or usability issues (Korhonen and Koivisto 2006). Rolling and Adams (2003) see the activity of gameplay as players facing upcoming challenges, like user create new content in geocaching all the time and get value in geocaching community of design something new in geocaching game. According to Cosfikyan (2002), good gameplay keeps the player motivated and engages him or her throughout the game. Underestimation of gameplay can be seen in the market in terms of entertainment games. Often, technology-based games that fail to meet their gameplay requirements, focusing instead on technological achievements, disappear quickly from the market (Kiili 2005). Folett (2007) defines gameplay and playfulness as a starting point for the UX of digital design, which connects people in the design process, taking them into account such that the design process becomes fresh and more joyful. Many other factors have affected gameplay and the

playfulness of products, as well as the technical features and functions, and how people use the product.

Järvinen, Heliö, and Mäyrä (2002) define playability as qualitative term for users to describe both the design and its evaluation. Playability is a collection of criteria which to evaluate products or services in terms of gameplay or interaction. Järvinen et al. (2002) have applied the gameflow framework in practice in the form of evaluating playability. Adopting playability as an evaluation tool, they present the following four components: 1) functional, 2) structural, 3) audiovisual, and 4) social playability. Functional playability is a precondition for the flow experience with games, which is balanced with the requirements of gameplay and input of the platform, as well as the interaction design of the product and service related to basic requirements. Structural playability has two variables that give structure to games. The game structure can be seen in terms of micro-level structures (the actual gameplay) and the macro-level structure (mission briefings and so on). In Geocaching game structure in micro-level is hiding and finding geocaches all over the world, because playground is our planet and macro-level mission could be user can find as many geocache places as for example 345 geocaches in Pori of Finland. The audiovisual style can shape the gameplay experience in a significant manner. Social playability is not only the desired context of use, but also about user cultures that foster an enjoyable, enticing, and meaningful sense of community. Rouse (2004) definition of the term gameplay. “A game’s gameplay is the degree and nature of the interactivity that the game includes, i.e. how the players are able to interact with the game-world and how that game-world reacts to the choices player make.” (Rouse 2004) Salen & Zimmerman’s definition is similar to Rouse’s, it more effectively captures these varied meanings mentioned previously, describing gameplay as “the formalized interaction that occurs when players follow the rules of the game and experience its system through play”. (Salen & Zimmerman 2004) In this thesis is defined gameplay in Geocaching which are users motivation, interaction and engagement his or her throughout the game.

3.3 Descriptive Models

3.3.1 Models of User Experience

This doctoral dissertation goes through selected user experience model. User experience models has separated three categories 1) user-centred, 2) product-centred and 3) interaction-centred models, and this doctoral dissertation GameFlow Experience model belong the group of interaction-centred models. Finally models and their components of user experiences are presenting in Table 3.

There is a long tradition of studying user experience in HCI, which has spread to other areas of research such as digital culture and game studies. Forlizzi and Battarbee (2004) identify three categories of the user experience models and frameworks; these can be 1) user-centered, 2) product-centered, or 3) interaction-centered.

UCD models have helped researchers, designers, and developers to understand people’s needs and uses of products. Hassezahl’s (2003) model describes the functionality and

hedonistic properties of the product, leading to 1) appeal, 2) joy, and 3) satisfaction (Hassenzahl 2003). According to Hassenzahl (2003), the hedonics/pragmatics model relates to actual experience in four different ways, making experience an explicit part of the model. First, it is assumed that product perceptions are influenced by actual experiences. Users may have an idea of the products and services' ability to satisfy them and their be-goals based on a first impression, but experience will modify any perception. Be-goals could understand basic human need, which is the driver of experience. The term of be-goal mean that user experience has fulfillment emotional responses with user first impression on the product. Pleasure: the extend to which the user is satisfied with their perceived achievement of hedonic goals of stimulation, identification and evocation (Hassenzahl 2003) and associated emotional responses (Norman's 2004) visceral category. If user experience fulfillment of be-goals through a product, they will attach hedonic attributes to it. In other words, measures of hedonics/pragmatics will inevitably reflect a summary of actual experience. In turn, perceived hedonic quality will be an indicator for potential fulfillment of be-goals through interaction with the product. (Hassenzahl 2008) Second, one may repeatedly provide perceptions during the experience to get an idea of how they change over time. Third, the hedonic/pragmatic model explicitly differentiates between perception and global evaluation (good–bad satisfaction). In other words, one may perceive a product as primarily hedonic, but this does not necessarily mean that it will be liked in a particular situation. Fourth, to account for the impact of the user's general state, two different usage modes are defined—goal mode and action mode. In goal mode, the current goal has a certain relevance and determines all action. Products are employed to achieve these goals. Meanwhile, in action mode, the operation is in the foreground, which will determine the do-goals that guide the be-goals, resulting in unstable do-goals. Using the products can be an end in itself (Hassenzahl 2003).

According to Bernd Schmitt (2000), describe on his book that, the aim of experiential marketing is to create a comprehensive experience for users. Experiential marketing has four key characteristics, as follows: focusing on the customer/user experiences; supporting the consumption situation; the assumptions of customers/users and feeling the effects of these and related research methodologies. Experiential marketing involves the following five relevant types of evidence of experience in strategy modules: search engine marketing, which forms the basis of marketing (the module is designed to facilitate consumers'/users' aims to create multisensory experiences), emotion (feelings of customers' marketing appeal), thinking (intellect), acting (targets affecting the physical experience), and touch (linked to an individual for themselves, other people and culture; Schmitt 1999, 26, 71, 73). Examples of the user-centered model are provided in Jordan's (2000) four pleasures framework, which involves 1) sociopleasure, 2) ideopleasure, 3) physiopleasure, and 4) psychopleasure (Jordan 2000).

Kerkow et al. (2007) examine the UX models in goal-oriented HCI studies. The most accepted model in software engineering that has conceptual familiarity to UX is quality in use (QiU), introduced by Nigel Bevan during the development of ISO 9126 (ISO/IEC 9126-4:2004). According to the standard, QiU is composed of the following aspects: 1) effectiveness, 2) productivity, 3) safety, and 4) satisfaction. Basically, QiU characteristics cannot be directly manipulated during the development process, which means that developers have to measure and

manipulate them indirectly based on the internal and external quality characteristics of the objects available. The QiU model tries to clarify user satisfaction in the medical industry.

The AMUSE quality model (Doerr et al. 2007) is theoretically founded, and its components are as follows: 1) effectiveness, 2) productivity, 3) joy and appreciation, and 4) trust. Kerkow et al. (2010) approach the concept of pleasure during the use of an interactive system from a cognitive point of view. The cognitive effects of the use of the software appear as an individual's subjective experience and behavior. Therefore, the e4FUN quality model is not about happiness, but rather motivation, attitude, creativity, and a desire to focus on working on the UX. e4FUN quality model is divided into the following four dimensions carried out based on the task: *1) Execute FUN is when hinder me: Here, the application should not prevent the user from accomplishing his task, but allow for effective and adequate working, that is usability. 2) Engage-FUN is when I meet motives: The key concept of this dimension is motivation; users shall be motivated and engaged during interaction. 3) Induce-FUN is when I change attitude: Here, users' attitude should change towards a predefined goal. 4) Expand-FUN is when I get illuminated: The main concept in this dimension is creativity. The target behavior for the user would be to acquire new tasks or goals by developing novel and creative ideas or usage scenarios the product has not been designed for*. (Kerkow et al. 2010)

Product-centered models provide a simple application of design practice in which information helps both designers and non-designers to create products that evoke compelling experiences. The models describe the experiences and issues that can be viewed through the design and evaluation of a product, service, environment, or system perspective (Forlizzi and Battarbee 2004). Product-centered models provide straightforward applications for design practice. They describe the kinds of experiences and issues that must be considered in the design and evaluation of an artifact, service, environment, or system. These models often take the form of list of topics or criteria to use as a checklist when designing. (Forlizzi and Battarbee 2004). For example, Alben (1996) offers a set of criteria for the quality of experience in the design, such as time perception, planning, and execution. Davis (1989) developed a model called the technology acceptance model (TAM) in the context of management science; like the QiU model, TAM is based on user satisfaction in the medical industry. Summarizing the model, technology acceptance involves 1) usefulness, 2) ease of use, and 3) intrinsic aspects. Garrett (2003) presents elements of a product-centered model of user experience, namely 1) appeal, 2) pleasure, and 3) satisfaction.

Battarbee and Mattelmäki's (2002) model focuses on meaningful relationships with products; these researchers present product categories that are not hardware, and are meaningful to the person. Battarbee and Mattelmäki (2002) presents meaningful product categories from the user experience point of view are Meaningful tool, meaningful association and living objects. However, the hardware is an integral part of the experience. *Meaningful tools* such as assistants meet the user's needs at all levels, such as security and mobility, as well as independence, sociability, and implementation issues. The challenge is to address why we need to invest time, money, effort, and attention into learning and mastering the skills and tools. As skills for self-expression, we often use creativity, productivity, and self-expression. It is rational to combine this relation with a product that is meaningful and refers to the significance of culture and the importance of the individual. (Battarbee and Mattelmäki 2002)

Products are built on personal experience (*meaningful association*) related to them, such as identity, personal, cultural, professional, professional experience, and symbols. Links to memory, people, feelings, stories, and objects remind us of the past events and experiences of people or families in general. Emotions are associated with memories, particularly objects (*living objects*), scents, materials, and appearances; these memories can create stories that become relevant to the person. (Battarbee and Mattelmäki 2002)

Interaction-centered models refer to the role that products serve in bridging the gap between the designer and user. Dewey (1980) discusses engaging the self in a relationship with an object in a certain situation. Wright et al. (2003) present experience from a design perspective as consisting of the following four components: 1) the compositional, 2) sensory, 3) emotional, and 4) spatio-temporal components. Margolin (1997) provides four dimensions that clarify how user interacts with design products, which are 1) operational, 2) inventive, 3) aesthetic, and 4) social uses. Overbeek and Wensveen (2003) focus on the aesthetics of interaction and the ways in which form and behavior support feedback. Information is coupled in interfaces and action in six ways, namely time, location, direction, modality, dynamics, and expression. When it comes to understanding experiences, user-centered, product-centered, and interaction-centered frameworks are limited, as they reflect not a design viewpoint, but rather a disregarded construction of meaning of design process and its context of use (Battarbee 2004).

This doctoral dissertation presents the GameFlow Experience model, which seeks to expand upon user experience models that help designers and developers to understand user experiences with treasure hunt applications in the tourism and education contexts. The GameFlow Experience model focuses on collaborative aspects of UX, such as interactions between individuals and applications, and their resulting effects. In addition, it stresses the importance of these experiences in the context of geocaching and treasure hunt games in tourism and education, in which users or geocachers interpret the five cases and create meaning. The framework describes user–product interactions (fluent, cognitive, and expressive), as well as the following dimensions of experience: 1) player experience and challenges, 2) social experience, co-experience, 3) players' creative experience, 4) emotion experience and feedback, 5) temporal experience, 6) educational experience, 7) immersion experience, and 8) narrative experience (P6). A summary of selected the user experiences models are provided below (Table 3).

Table 3. Components in the models of user experiences.

Reference	Models with Components
Davis (1989)	TAM: Usefulness, ease of use, intrinsic aspects
Alben (1996)	Conception, planning, execution
Margolin (1997)	Operational, inventive, aesthetic, social uses
Schmitt (1999)	Strategic experiential models: Sense, feel, think, act, relate
Battarbee and Mattelmäki (2002)	Meaningful tool: Facilitator, challenge, self-expression
Garrett (2003)	User experience element: Appeal, pleasure, and satisfaction
Hassenzahl (2003)	The pragmatic and hedonic model Product attributes: Appeal, pleasure, and satisfaction
Overbeek and Wensveen (2003)	Time, location, direction, modality, dynamics, and expression
Wright et al. (2003)	Compositional, sensory, emotional, spatio-temporal
Bevan (2001)	QiU: Effectiveness, productivity, safety, satisfaction
Doerr et al. (2007)	AMUSE: Effectiveness, productivity, joy and appreciation, trust
Kerkow et al. (2010) (effective),	e4FUN: dimensions: Accomplishing the task motivated (engaged), persuaded (predefined goal), illuminated (creative ideas)
Ihamäki (2014b)	GameFlow Experience model: Player experience and challenges, social experience, co-experience, player, creative experience, emotional experience and feedback, temporal experience, educational experience, immersion experience, and narrative experience

3.3.2 Models of Player Experience

Sweetser and Johnson (2004) have studies issues related to games' impact on player enjoyment. Their principal components consist of physics (gravity, life-like graphics), sound (effects and soundtrack), narrative, intuitiveness (interaction with objects), and the freedom of expression (many different as well as unique ways of using objects). Like Karl Groos (1991), many theorists have focused on analysis of the pleasure of gaming experience; for example, Costello and Edmonds (2007) describe a framework for the joy in 13 categories of gaming, which evolved from a synthesis of six theorists who have approached play and pleasure from different points of view. First, the framework includes enthusiasm from the theories of Karl Groos (1991) and Roger Callois (2001), whose ideas were inspired by a desire to precisely define the gaming experience. Second, the

framework contributes to the idea of Mihaly Csikszentmhalyi (1975), who focuses on player types with experience, and Michael Apter (1991), who investigates the stimulation of gaming. Finally, the game designers took advantage of the ideas of Pierre Marc Garneau (2001), who were interested in the pleasure of the typical group of games (Hunicke et al. 2004) and playful practices resulting from the experience of everyday activities and products.

Ryan et al. (2006) present the player experience of need satisfaction (PENS) framework deals with the factors that keep users playing the games. The PENS framework consists of the following: in-game competence (capable and effective), in game autonomy (free to do things of interest), presence (physical, emotional, and narrative), and intuitive controls (easy to remember). In addition to PENS measures, subjective vitality (energy and aliveness), self-esteem, mood, game enjoyment, preferences for future play, and continued play behavior have been measured (Ryan et al. 2006).

Digital gameplay is also a type of HCI, whether it occurs between a player and a game (enjoyment, cache place, rules, etc.) or among players, interface-mediated interaction is the basic focus of digital gameplay. Hence, UCD plays a major role in digital games; at the same time, it forces us to conceptualize games as interactive systems—systems designed for fun, entertainment, and discovery rather than for professional productivity, but nonetheless computer systems with their own issues of usability, aesthetics, and satisfaction (Bardzell 2008). When playing digital games, players carry out thousands of actions and there is games which are not actions so much. During this time, a player's perception of the state of the game becomes crucial, as the player uses information gathered in order to arrive at an awareness and interpretation of a given situation, which in turn guides further activity. Digital game usability, in part, covers the extent to which a game successfully supports this action-guiding awareness or interpretation. Donald Norman (1988) emphasizes four principles, as follows:

1) *Visibility:* Through perception, the player can easily understand the state of the system and determine alternative actions;

2) *A good conceptual model*: The system allows a consistent and coherent presentation of the system throughout;

3) *Natural mapping*: The system enables a natural relationship between the controls and their utilities; and

4) *Feedback*. The player receives continuous feedback about the result of his/her action.

Norman's design principles can readily be seen in popular digital games. Once perceived, the players can approach and create new geocaches (good conceptual model). The geocachers start to be more creative because the geocaching community gives them a pleasurable experience and appreciation of their efforts. When the player creates a geocache in the real environment, there is a local volunteer geocacher who controls and checks it before the new geocache is published on the Geocaching.com web site (natural mapping). The success of the geocache is often represented as a feeling of winning and sharing one's experiences in the community. The players in the geocaching community give feedback, and then the player can proceed to the next adventure. The player is able

to interpret the situation and take appropriate actions in the game by using the interface efficiently, and can then view the resulting effects (Dyck et al. 2003).

When we look at game culture, it is easy to perceive how the commercial production of colorful digital games of mass appeal has modified how the history of player experiences has taken a certain shape. (Mäyrä 2007) According to Ermi and Mäyrä (2005b), the gameplay experience model has three dimensions, as follows: 1) sensory immersion related to the audiovisual aspect of the games; 2) challenge-based immersion that passes on feeling of immersion and can create balance of challenges and abilities; and 3) imaginative immersion, which allows users to enjoy the game. SCI (Sensory immersion, Challenge-based immersion, Imaginative immersion) model identifies the three key dimensions of immersion, which are related to several other fundamental components, and have a role in the formation of the gameplay experience. The first dimension of game experience that Ermi and Mäyrä (2005b) distinguish is distinctive sensory audiovisual implementation in games. Certain digital games are developed with audiovisual effects, as three-dimensional and stereophonic worlds that surround the players in a comprehensive manner. Another form of immersion is a key factor in the games, because they are based on the interaction of challenges. Ermi and Mäyrä (2005b) see a dimension of game experience in which one is embedded in the stories and the world, or begins to feel or identify with the game character, discovery, and embedding. In this thesis, player experience design could see the dimension of an embedded in the geocaching stories on the world and discovery for own identity of Geocaching community. An overall player experience models is always pre-defined, modified and post-defined by the multiple dimensions that are all parts of the networks of signification for digital play and games, in several general and particular levels. (Mäyrä 2007)

3.4 Design and Evaluation of User Experience

This thesis focuses on understanding the UX and examines component of experiences which influencing geocaching education and tourism. With theory of user experience and empirical findings of this dissertation extend user experience models with GameFlow Experience model. Depending on the context and objectives of the system, the UX can vary from supporting users' quality of life and well-being (pleasure, being pleased, trust, security), personal growth (e.g., challenges, fun, entertainment) and free interpretation (personal contacts, emotions) (Vyas and Veer 2006). UX has a comprehensive nature, especially in designing experience that needs to address various aspects. A basic requirement for a good UX is to meet the needs of the user. Similarly, the design must be multidisciplinary, involving an engine hardware, marketing, industrial design, and information architecture (Olsson 2012, 28). Thus, UX design starts with the concept of the level, before it is implemented in specific demonstration systems (ISO 2010).

Designing the UX will bring new challenges to consider. New terms and conditions, such as emotional design, experience design, and experience-driven design are being developed accordingly. Norman (2004) defines *emotional design* and its target into three levels—visceral, behavioral, and reflective—which are based on psychological research on emotional processes. This researcher describes interaction at the visceral level of emotional design as instinctive, which is

captivated by stimulation of the senses, including hearing, sight, touch, taste, and smell. Once the user receives a sense of stimulation and responds to it directly, he or she will engage in diverse emotional interactions. The visceral belongs to an initial level, and it is the most direct and irresistible one. Norman (2004) argues that the design of the visceral level can appeal to the user's sensory experience. He emphasizes the role of the premier appearance in improving the user's experience on a visceral level (Norman 2004). *Experience design* therefore designs UX as joy and fun (Hassenzahl and Tractinsky 2006). Thus, a number of researchers have taken steps to better understand the user experience (Law et al. 2009; Roto and Kaasinen 2008). The common factors are the UX flow element, which can get user to immerse in the level of enjoyment and fun state. Desmet and Schifferstein (2008) describe an *experience-driven design* approach that aims to create a specific UX. Desmet and Schifferstein (2012) present experience-driven design with a holistic approach, where the design team ensure that all different elements of the design (e.g. function, appearance, grip, sounds, communication) support the UX. Desmet and Schifferstein (2012) present the experience-driven innovation model, which includes a contextual description of vision formulation, concept generation, and end result.

According to Wright and McCarthy (2011), experience-centered design is a process that values the whole person behind the targeted experience as a central concept in the design vision. Hassenzahl (2008) describes the concept of flow, which is very close to the idea of the value of UX, which he describes as being a temporal, positive experience resulting in the optimum balance between challenges and skills in a goal-oriented environment (Hassenzahl 2008). Cheng and Cairns (2005) describe the user experience from the game design point of view; the players have to be interested in the achievements of the game and the immersion mode. When the user continues the game, he or she also agrees to it and receives encouragement. When the game depends on the player's emotions, this has a direct impact on the game. The total flow experience is the most immersed experience a user can obtain. She or he will be completely involved in the game and experience absolute presence, where only the game and the emotions produced by it matter (Cheng and Cairns 2005). The planning system provides a tool for action, but it is the user that gives it meaning and purpose. All in all, this is the essence of experience in the design of the system to identify the user or the intended connection that can be designed (control). To recognize the aspects of the whole is to understand the user and the connection of users in game design. The negativity is reduced, and the experience may then turn positive. However, this is a challenge that needs to be supported with empirical research on UX and new kinds of guidelines and considerations (Olsson 2012, 29).

UX design and evaluation are challenging because they are dynamic and subjective. Vermeeren et al. (2010) argue that there is no acceptable standard method for estimating the user's experience. In their survey, they evaluated 96 methods in terms of the source of research data, the type of data they could collect, what could be utilized in the development stage, and what to measure in the overall user experience (Olsson 2012; Verneeren et al. 2010). Researchers have adopted the methods of marketing, psychology, and the study of interaction, as well as the assessment of each case, taking a particular approach to connectivity, the target users, and interest in the area of the holistic user experience (emotions, aesthetics, fun, flow). The UX is subjective and the criteria for a user apply a standard of comparison for personal knowledge and past

experiences (Olsson 2012). The examination of UX via survey is an accepted procedure (Laugwitz et al. 2008). Other methods used to study user experiences include, for example, emotional states, interviews, and observations used to collect experience for the sample are subjective descriptions of the UX and expert reviews to evaluate the products in terms of the UX (Olsson 2012; Väänänen-Vainio-Mattila et al. 2008) A key part of UX research is the method of assessment, and in particular, a quantitative measure for models that describe the specific aspects of the user experience or interaction. Law and Schaik (2010) have highlighted the value of the study to determine the models of UX in order to achieve a selected level, to identify and create operationally meaningful measures that are within the theoretical framework, and to determine the nature of the property and the construction of the multidimensional UX, as well as to become an expression of the operationalization of such measures.

User experience studies allow the evaluation of benchmarking solutions and choices and iterative design solutions (Law and Schaik 2010). In other words, it is possible to assess these by 1) first identifying the meaningful concepts, 2) constructing and creating goals that can be measured, and 3) carrying out the assessment only after they are useful. The complexity of the UX requires a conceptual study prior to construction and rendering. Law and Schaik (2010) emphasize that special attention must be paid to establishing models of UX. First, the concept of time of a user's activity can have a significant impact on the content. Second, experience belongs to a specific type of interaction (flow of activity and sensory response) and has aspects of social cognition, such as technology acceptance. Third, there is a specialization to a certain time, which means that the UX can be modeled at a certain point in time or time interval, or that the process time is a static model rather than a dynamic one. Fourth is a model related to cultural differences and user activity. Hosted (2006) has studied members of the community in which conceptual structures and functions in different cultures are formed. All in all, this means that any UX requires design with a concept model of a specific timetable and experience (Olsson 2012).

In this doctoral dissertation, the GameFlow Experience model can be understood as an experience-driven design that aims to create a specific UX in geocaching applications for the fields of tourism and education. The model's experience-driven design includes a contextual description of vision formulation, the users of concepts, and the end results. This dissertation presents five case studies of real-life contexts, each of which include contextual descriptions of geocaching applications for the fields of tourism and education, the users of concepts, and end results.

3.5 Summary

In summary, the UCD are umbrella-like approaches including participatory design, human-centered design, usability measurements, and UX design. The chapter defined pervasive games and presented components of the pervasive game design, giving direction to the adventure game design. In this chapter, the definition of gamification was presented, which is an informal umbrella term in this dissertation for the use of digital game elements in non-gaming systems to improve UX and user engagement in geocaching applications for the fields of tourism and education. The chapter also described gameplay, which offers a direction for the GameFlow Experience model. The chapter covered the models of UX and player experience, which are based on relative research. Finally, this section described the design and evaluation of UX. The section highlighted research and created a model for UX studies, namely the GameFlow Experience model, in the context of Geocaching in tourism and education.

4 Methodological Viewpoints and the Research Process

This chapter describes the goal of this doctoral dissertation in terms of its methodological viewpoint. Section 4.1 describes the methodological triangulation in this dissertation, while section 4.2 covers case study theory and presents the dissertation's research process. Furthermore, subsection 4.2.1 presents all user studies after going through the system of Geocaching game from the perspectives of context of use, physical context, task context, social and cultural context, temporal context, and technology context. Following this, subsections 4.2.4 look deeply at all data collection and methodologies for case studies. Finally, I have combined all six case studies in the analytical phase of testing, which fit with the goal to use triangulated, mixed-method design experiences in the GameFlow Experience model.

4.1 Methodological Triangulation

Triangulation consists of data sources or approaches, viewed as an opportunity to uncover deeper meaning in the data. Methodological triangulation involves the use of multiple qualitative methods, for example, the results from SAM, focus groups, surveys, and usability tests could be compared to see if similar results are found. If the conclusions from each of the methods are the same, then validity is established. Triangulation can be used to deepen the researcher's understanding of the issues and maximize their confidence in the findings of qualitative studies (Guion, Diehl, and McDonald 2002). Methodological triangulation consists of data collection and analyses, which are used with a number of methods (mixed methods), measures, or approaches that cover research on new phenomena or product requirements. To perform HCI studies, the researcher must independently investigate the use of experience and user information for all points of similar problems, and this approach will produce a result of the different data collection methods, which will help convince researchers to focus primarily on problems that are usually generated with the methods. One of the fundamental aims of the researcher is to design a study that has a comprehensive multiperspective point of view, and procedures to reduce the potential biases in the study (Mitchell 1986). Different research methods should be used to understanding UX, such as survey research, focus groups, and informal testing (Sullivan 1991).

Methodological triangulation offers the possibility to explore unique differences of relevant information that may have remained undetected compared to a single approach or data collection technique. While exploring the experiences taking place in a real-world environment, the following factors should be taken into account: 1) natural moving in a real environment (by walking, bike, or car), 2) the action that participants carry out (researcher observation), 3) the surrounding environment, and 4) how users interact with the environment or a participant interacts with other users in the environment. A number of items examine the system's capabilities and related human factors such as distractions in the user's performance, display quality, modes of consistency, and realism. However, these questions can be seen as a clear move toward the estimated experiential elements such as presence (Olsson 2012, 49). Takatalo et al. (2008) have conducted virtual environment research, which usually consists of a physical presence, context-sensitive participation,

and expertise. Similarly, when designing new products or applications, only guidelines can be given based on estimated results specific to the study case and interaction (Olsson 2012, 48–49).

This study used methodological triangulation, in which different approaches are applied to all stages throughout the research, as mixed methods can often extend beyond the research itself. The use of a mixed method in this dissertation provides the possibility to understand the user experiences in a Geocaching game and the GameFlow experience model's characteristics through theory and empirical findings. The mixed methods and qualitative approach may raise a number of issues when working in different contexts (Barbour 1998), as in other disciplines. This happens, for example, when I work in game culture in the humanistic discipline, or when as a researcher I engage in the study of UX in the HCI technical discipline in order to evaluate the impact of this work (Caracelli and Greene 1997). This dissertation triangulation matrix is presented in Table 4.

Table 4. Dissertation triangulation of the matrix (based on Mills 2003, 52).

Publication	Theory	Methods	Material/Data	Research Questions
P1 The Creative Potential of Treasure Hunt Games to Enhance Positive Emotions During Experiences Relating to Local Geography and History	User experience, experiential learning theory, emotional experience	The SAM measuring generalized emotional states. Self-report methods were used for collecting UX information in field experiments. The *expressing emotions and experiences* (3E) idea is that the emotional expressions could be used 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.	The result included a questionnaire using the SAM method and versatile material about children's experiences and emotions related to them. The material consisted of 110 students' questionnaire answers and exercises, which allowed children to express their emotions with a combination of a picture and an explanatory text.	RQ1) What kind of user experience does the geocaching game offers for users? RQ1a) What are the components of the experiences that influencing geocaching in education?
P2 Designing Pori Hidden Beauties Geocaching Road—Facebook as a Tool of Collaborative Learning And Sharing Experiences	User experience, co-experience. Game design, experiential learning theory	Contextual interview supports the productions of general-purpose systems and provides us with a way to work for short periods of time at multiple customer sites. It helps people to crystallize and articulate their experiences. It also fosters teamwork and the development of a shared, consistent system vision in the geocaching course.	The data consist of contextual interview materials in a course called "Pori Stories based on the Game of Geocaching" at the University of Turku, Cultural Production and Landscape Studies. The material also consists of narrative stories for geocaching places, pictures, and video materials that were made during a Geocaching course at the university.	RQ1) What kind of user experience does the geocaching game offers for users? RQ1a) What are the components of the experiences that influencing geocaching in education? RQ2) What are the characteristics of experience in a geocaching game and its applications to tourism and education? RQ3) What kind of design guidelines support geocaching and its applications in tourism and education?
P3 Geocachers: The Creative Tourism Experience	Creative tourism experience, user experience, experience triangle, location-based experience, and user-centered design	This case study gathered geocachers for an Internet survey and is based on 52 responses.	The material contains Internet survey responses. The secondary material is based on Geocaching stories in magazines all over the world, linked to Geocaching.com, which 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.	RQ1) What kind of user experience does the geocaching game offer for users? RQ1b) What are the users experiences that affect the treasure hunt concept in tourism? RQ2) What are the characteristics of experience in a geocaching game and its applications to tourism and education? RQ3) What kind of design guidelines support geocaching and its applications in tourism and education?
P4 Geocachers' Creative Experiences along the Coastal Road in Finland	Creative experience, location-based experience, user experience, user-centered design	Descriptive case study is not solely a narrative case study or a general descriptive article; it also has similarities and connections to theoretical reasoning. The descriptive case study can be useful in yielding information on the shape and nature of existing uses. This case study describes geocaching as collecting travel experiences and aspires to understand geocaches situated along the Coastal Road in Finland.	This paper is based on the geocachers' interview material, the Geocaching.com Groundspeak forum conversations (observation), and Geocaching articles from other sources. The data in this case were collected by email; semi-structured interviews were conducted with 23 geocachers in 2004 and a second round of semi-structured email interviews was conducted with three selected geocachers, who had placed geocaches along the Coastal Road in 2008.	RQ1) What kind of user experiences does the geocaching game offer for users? RQ1b) What are the users experiences that affect the treasure hunt concept in tourism? RQ2) What are the characteristics of experience in a geocaching game and its applications to tourism and education?
P5 Understanding User Enjoyment with Geocaching Application	User experience, game design, user-centered design	This case study methodology based on a usability test, one survey, and one evaluation sheet for users and is based on 17 responses. The users first needed to fill out the geocaching application software 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.	The material contains survey and evaluation responses. The secondary material is based on observation and discussion of the field usability test.	RQ1) What kind of user experience does the geocaching game offer for users? RQ2) What are the characteristics of experience in a geocaching game and its applications to tourism and education? RQ3) What kind of design guidelines support geocaching and its applications in tourism and education?
P6 GameFlow Experience Model: Understanding Player Enjoyment in Pervasive Adventure Games	User experience, user-centered design, game design	Concept analysis utilizes the method of reasoning, where both analysis and synthesis are applied to produce new concepts and frameworks. As a research approach, conceptual analysis is purely theoretical, and is based on literature study. Broader concepts are elaborated and deconstructed into smaller parts to better understand their elements.	The material consists of all dissertation data material, since this article concludes this dissertation. The material also includes the newest Geocaching research as a literature review and has been extended by adding Geocaching news from the Geocaching.com webpage.	RQ1) What kind of user experience does the geocaching game offer for users? RQ2) What are the characteristics of experience in a geocaching game and its applications to tourism and education? RQ3) What kind of design guidelines support geocaching and its applications in tourism and education?

4.2 Case Studies and the Research Process

Case studies have had a variety of applications throughout history. The case study refers to qualitative research that usually includes a small group of participants (George and Bennett 2005; Yin 1994), and the research is holistic, giving a more or less complete description of the phenomenon (Verschuren 2001). It may also use ethnographic, participant observation, textual content, or field research (George and Bennett 2005; Hammerley and Gomm 2000; Yin 1994) A case study is a method of gathering evidence from the natural real-life context (Yin 2003, 13); the subject is fragmented (the case and the context are difficult to distinguish; Yin 1994, 123), and triangulation is used with a number of sources and methods to elucidate the phenomenon. (Yin 1994, 123) In case study, the researcher investigates a single phenomenon (George and Bennett 2005, 17). This case study approach clearly acknowledged that the complexity of the problems to be studied not only requires a decomposed, variable-oriented, qualitative approach, but also depends on the individual case (Abbott 1992). Case study research may incorporate several cases, which is then multiple case studies. At the point where the emphasis of a study shifts from the individual case to a sample of cases, we say that a study is cross-case (Gerring 2007, 20).

This doctoral dissertation incorporates six case studies that present the Geocaching phenomenon in the context of education and tourism. The research process consists of six case studies and six main phases, as illustrated in Figure 5. Altogether, 204 persons of various nationalities and backgrounds participated in the five case studies, while the fifth case study combined all of the previous studies to make a synthesis.

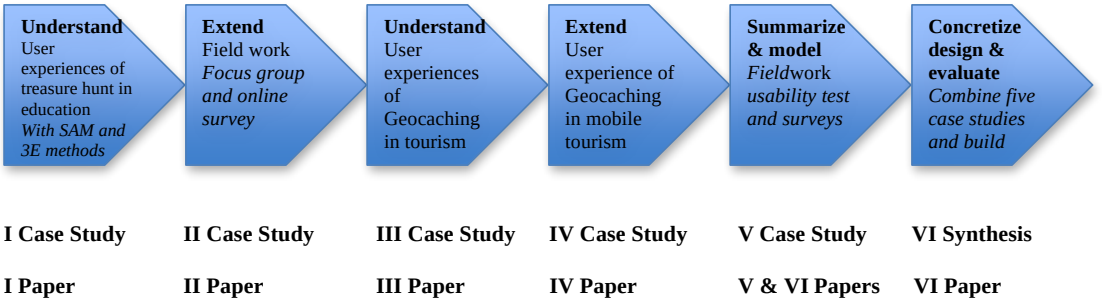

Figure 5. The overall research process in terms of the main goals of the phases, and which studies contributed to each of the publications.

4.2.1 Users

All five case studies have different segments of user based on using treasure hunt games and geocaching in the context of education and tourism. In the optimal case, the sample selection criterion in service development–oriented quality evaluation studies should target potential users (Engeldrum 2000). Each of the case studies had 10–110 participants, forming a broad pool of data from over 216 participants. The results of these studies were published in six scientific publications.

The first case study included 110 students from 2nd and 4th grades in a centrally located primary school in Pori, Finland. The users in the first case study were primary school students; this target group is one of the segments in using geocaching and treasure hunt game in education to teach local history and geography. In the first case study, targeted to one school with the potential user group for a treasure hunt game and Geocaching game in education, a group of students evaluated the acceptance of local history and geography content when they moved and found geocaches and carried out exercises on the Pori Cultural Heritage Road.

The second case study targeted university students, which are a potential user group for creating new content in a geocaching game. They used geocaching as a platform in education. Outside the Geocaching game in the education field, the influence of cognitive styles on the perceived Geocaching in education has been examined in some studies (e.g., Mayben 2010). Cognitive style takes into account the characteristics and consistent approaches to process information (Jumisko-Pyykkö and Utriainen 2011). The studied cognitive styles focused on 1) multisensory orientation (verbalizer, visualizer) emphasizing the role of information presentation and 2) field-dependent processing styles (field-dependent learners, intermediate and field independent learners) characterizing the way the surrounding perceptual field of Geocaching in the education context contributes to learning.

The third case study included 52 participants from Finland who played the geocaching game. The average age of the participants was 37, and it ranged from 14 to 63. The users were active Geocaching players; 5 participants out of 52 had found more than 1,000 caches, and most of the participants had found 200 to 400 caches. Users who play the Geocaching game were active participants in the group, because they were also interested in evaluating the Geocaching game and participating in the research. The results of the study showed that geocachers represented an advanced user group and that the expectations and experiences for using Geocaching in tourism are modified by the perception of these geocachers compared to other segments of tourists. Geocachers seem to be very creative users who want to use the geocaching game in tourism and other contexts.

The fourth case study involved 26 participants from Finland who played the geocaching game. The case material was based on geocachers' interview material, the Geocaching.com GroundSpeak forum conversation (observation material), and geocaching articles from other sources linked to Geocaching.com. The survey material selected three geocachers who had hidden a geocache along the Coastal Road and participated in semi-structured email interviews. The geocachers wanted to share their own special experiences with other players and make destination geocaches so that players could create their own experiences in searching geocaches.

The fifth case study comprised 17 participants from six different countries; the age distribution was between 17 and 57 years. The results showed that users enjoyed real-time gaming played in the physical world, along with the GeoCentria application, and they engaged in social experiences and co-experiences when playing the geocaching game in the context of tourism. Because the group of users was technology-oriented, they had good skills to evaluate the GeoCentria application in the context of tourism and present design guidelines on a usability test. Thus, the users were interested in using new technology services in the context of tourism.

Beyond these end-user-oriented case studies, the most common way to classify a sample into native or expert evaluators is based on domain-specific knowledge. In this study, a native evaluator refers to a person who is not playing a geocaching game and has not experienced a geocaching game previously. In contrast, an expert assessor has high involvement in geocaching games and has played geocaching for a while. In these six case studies, the first case study includes young students who have not played geocaching games before. In the second case study, the students had heard about geocaching but had never played a Geocaching game. In the third and fourth case studies, the participants are experts of geocachers. The fifth case study is a usability field test, and the participants are international students who have never played a Geocaching game before. The sixth case study combines all five case studies and evaluates all cases, making it a synthesis.

4.2.2 System

The Geocaching game is based on a certain GPS location with specific coordinates. Geocaching is a combination of multiple factors; it is a game carried out by players who use GPS technology in a new way. It can thus be seen as a pilot test area for game designers and developers (Ihamäki 2012b).

Players in the virtual Geocaching environment can communicate with each other in chat rooms and in a large geocaching forum called *Groundspeak*. Different countries have designated particular local forums. For example, there are forums for teachers who use geocaching in education; journalists have a forum in which they share ideas for Geocaching articles; in the Game Content and Roles forum, players share ideas and develop the game together. In the game, the virtual environment includes the Internet-based network of discussion forums and chat rooms, as well as applications for cell phones. Players are starting to bring geocaching into everyday life and the impact of setting up gamification elements in everyday action, crossing, and breaking the boundaries between game and non-game.

Taylor (2006) notes that “virtual” spaces leak into the “real” world and that the practices of play are integrated with those of everyday life. MR (Mixed Reality) Geocaching game is based on the physical world requirements demanded by the game, with which the virtual world can be involved at the same time. Mixed reality is a collective term for concepts about integration of the real and virtual realms (Millgram & Kishino 1994). Geocaching takes advantage of the natural mobility of devices such as mobile phones and GPS devices, which are independent of the area of play. Combining the virtual and real domains leads to new interaction paradigms such as tangible interfaces, which are considerably more attractive and intuitive than traditional ones. For electronic games, this technology offers even more advantages (Ihamäki 2012b). The official Geocaching.com website for the game provides a framework for the hobby, but all content shared is user-generated. This reflects geocachers’ motivation to engage in the game itself. Geocaching also opens possibilities for experimental technical applications, and Geocaching.com offers tools and downloads for players. Geocaching.com collected own side of different applications and have own project where experts can participate in through the open data to develop a new applications. Geocaching.com is sharing on website of its own Windows applications, for example, OkMap,

ClayJar Watcher, GPX Spinner, GPSBabel, and CacheStats; Mac applications Routebuddy, GPSBabel, MacCaching GeoCahe Manager, and iCaching; and Linux Applications GPS Manager, Viking, GPSBabel, and so on (Geocaching.com/software, news on 10.3.2013). Geocachers use technology in their pursuits; what makes this interesting is that the devices and the system have a special meaning. Geocachers have added new user-generated content to the web world and to the real world, using techniques that have been developed for military use as a treasure hunt. Geocachers are interested in the development of technology, and a variety of services for potential use in the game (Ihamäki 2012b).

GPS was developed by the US Department of Defense. This satellite navigation system was intended for military use, and therefore the signals were scrambled, limiting the accuracy for civilian use to about 100 meters. On May 1, 2000, President Clinton announced that this scrambling, known as selective availability (SA), would be turned off. Civilians were then able to enjoy accuracy on the order of 10 meters (Tony 2010).

4.2.3 Context of Use

In the field of HCI, definitions of context give a broad overview of the major relevant factors. This doctoral dissertation belongs mainly in HCI research field, that's why definition of context has look at in mainly in HCI perspective. According to Dey (2001), *"Context is any information that can be used to characterize the situation of an entity. An entity is a person, place, or object that is considered relevant to the interaction between a user and an application, including the user and application themselves"* (5). According to the ISO standard 13407 (1999), *"context of use is related to 'user characteristics, task, as well as technical, physical, and social environment."* Roto (2006) developed an extensive model for UX in mobile browsing with systematic definitions of the terms "user," "system," and context-related factors" that offered a vocabulary for the field.

In the past, context was understood in terms of objective, physical, and external properties, following the ideas of natural sciences and systems theory (Svanaes 2001; Ishii and Ulmer 1997). Understanding these behavioral aspects of the context can improve design and make context-aware systems beneficial (Bellotti and Edwards 2001; Bradley and Dunlop 2005). According to Bradley and Dunlop (2005), *"context dependency implies that when some aspect of context is used explicitly or intrinsically in a given situation, that aspect of context is required for that situation to occur"* (407). According to Suchman's (1987) situated actions, every course of action depends in essential ways on its material and social circumstances. Context as a dynamic construct is characterized as taking into account a period of time, episodes of the user, social interaction, internal goals, and local influences (Greenberg 2001). Bradley and Dunlop (2005) defined a multidisciplinary model for context in which user-application interaction is surrounded by task, physical, temporal, and social dimensions. Roto (2006) proposes a similar categorization derived specifically from mobile browsing context. In mobile HCI, the studies of context of use repeatedly highlight its dynamic and heterogeneous nature, even if is not listed as a component of context of use in any studies (Cui et al. 2006; Kaasinen 2003; O'Hara et al. 2007; Väänänen-Vainio-Mattila and Ruuska 2000). There can be a primary or secondary user context, each of which will have different characteristics. In summary, different categorizations of the components of user

context fall into five main categories, namely physical, temporal, social, task, and technical context (Jumisko-Pyykkö and Vainio 2010).

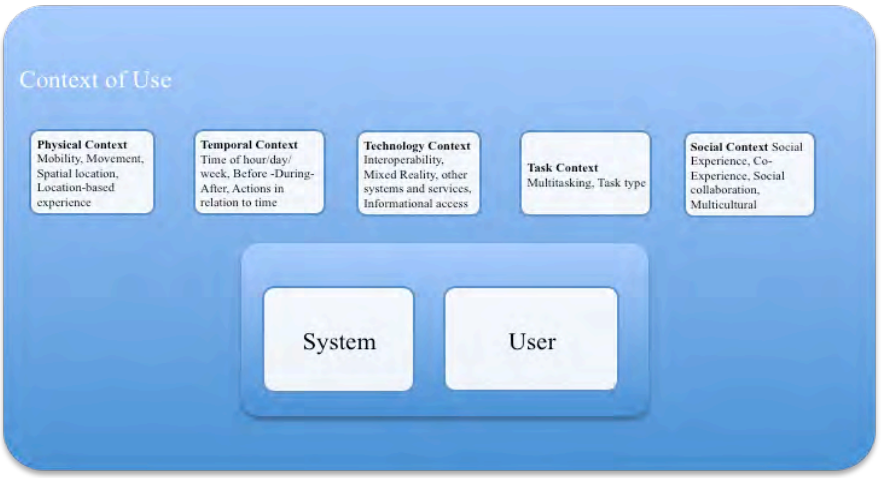

Figure 6. Modified model of user experience context of use (Jumisko-Pyykkö and Vainio 2010).

Physical Context

Physical context describes the features of a situation in which the human-mobile computer interaction takes place, including spatial location, functional place, sensed environmental attributes, movements, and mobility and artefacts presents (Belk 1975; Jumisko-Pyykkö and Vainio 2010; Roto 2006). Physical context of use was discussed in the *second case study*, where the students communicated in a spatial location face-to-face in the classroom and virtually through the Facebook group. To fully understand the role of a student in web-based communities, the virtual environment must be treated as a functional place with the physical environment. Students shared location-based experiences through the creation of the "Pori hidden beauties" geocaching series (P2). In more detail, according to Bradley and Dunlop (2005), physical context includes location, gradient and altitude, physical objects, orientation, and weather and lighting conditions. Spatial location and functional place include aspects of location and material characteristics of location and functional place (city areas, sport fields). Location and material characteristics of location may be geographical and may contain a description of relevant landmarks (Bendford et al. 2005; Cheverst et al. 2000; Jumisko-Pyykkö and Vainio 2010; Olsson 2012). Mobile computing has taken a location-dependent approach to physical context (Dey et al. 2004). In terms of functional place, location-based experiences and mobile interaction includes multiple places, for example, school, work, home, the cinema, or transportation (Jumisko-Pyykkö and Vainio 2010; O'Hara et al. 2007). This specific domain of context research focuses on location in a real physical environment; that is, when developing context-aware applications, the information presented to a user is based on his or her geographical location. This means that the physical context may also imply physical conditions

such as lighting or infrastructure (Barnard et al. 2007) or background and environmental noise, as well as weather conditions (Smith et al. 2006).

Location-based experiences have expanded digital culture out of the physical world—be it on the streets throughout the city, or as part of the remoteness of the desert. Users of mobile screens can move across the world. The sensors capture the information about the current situation, including their location, and this is used to operate according to where one is (the sense of place), what to do (find treasures), and maybe even how to feel (how the excitement of new experiences; Benford 2005. Location-based applications take advantage of location information to support the mobile interactivity in areas such as tourism (Abowd et al. 1997; Cheverst et al. 2000), information retrieval (Brown and Jones 2001), the use of resources (Imielinski and Navas 1999), workplace awareness (Want et al. 1992, 1995), resolution (Benford et al. 2004; Crabtree et al. 2004), and games (Björk et al. 2001; Piekarski and Thomas 2002).

Following this, the user receives opportunities to access digital media content like geocaches on their mobile phone and to share a variety of experiences that are tied to their everyday lives, which can be done even during holidays. Benford (2005) has studied the location-based applications of cultural heritage sites and tourist routes and has received a lot of attention from researchers in recent years (e.g., Abowd et al. 1997; Belotti et al. 2001; Cheverst et al. 2000). However, by focusing on the "real-time information and access of this information," a lot of these studies have focused on that and have shared information applications and users' behavior and motivation to use the updated location-based information with their everyday life. This can be seen, for example, in location-based entertainment and location-based games and story-telling services. However, pervasive games or augmented reality games, where the environment or part of it is simulated, the experience of the environment is often a real public space in which physical structures and social protocols are predefined. Agile technologies, such as GPS, cell-phone-detection technologies, and network triangulation, allow users to utilize their physical locations in a game. The word "agile" in itself refers to something flexible and responsive, and agile technologies seek to adapt and operate quickly (Anderson 2004). Location-based services (LBS) have now become an important part of m-commerce strategies (Rao and Minakakis 2003). Mobile commerce is defined as all activities related to a potential commercial transaction conducted through communications networks that interface with wireless (or mobile) devices (Tarasewich, Nickerson and Warkentin 2002). The term m-commerce is being treated as substantially equivalent to the term m-business. In this thesis physical context understanding, which human-mobile computer interaction take place, including functional place like geocache location in urban environment middle of the street.

Temporal Context

Temporal context of use can describe factors of past and future situations, from time of day to the week, month, or season (Belk 1974; Bradley and Dunlop 2005). This context is relevant to everything, and can provide significance for the current situation based on the previous situation or event, like geocaching events, especially CITO events in geocaching (which always occur in April at the same time every year in every country). Temporal association may be related to time of day,

week, month, or year (Bradley and Dunlop 2005). Temporal context also covers the time available for completing the task (Roto 2006). It starts during the first time of use, and its eventual success depends on its continual long-term use. In the first case study, students and teachers were allowed the opportunity to express the temporal experience, as *"treasure hunt day gives students an experience day"* (Ihamäki 2014c). In Geocaching, temporal context is based on the Geocaching action in time.

Roto et al. (2011) refer to an encounter with a system that has a beginning and an ending a period of use (e.g., using a navigator to get from place to another). Rather than its dynamic nature, this term emphasized the outcomes and memories of experiencing. (Roto et al. 2011) It is important to understand the different levels of abstraction in describing the UX temporality or period of time (Law and Schaik 2010; Roto et al. 2011). Because the UX is dynamic and highlights the time interval to experience, it refers to the continuous perception, interpretation, and hours that the individual user spends interacting with technology. The experience of the user refers to the encounter with a beginning and an end—the time of use (for example, geocaching navigation from place to place, and finding a geocache).

Roto et al. (2011) present four timespans of UX (Figure 7).

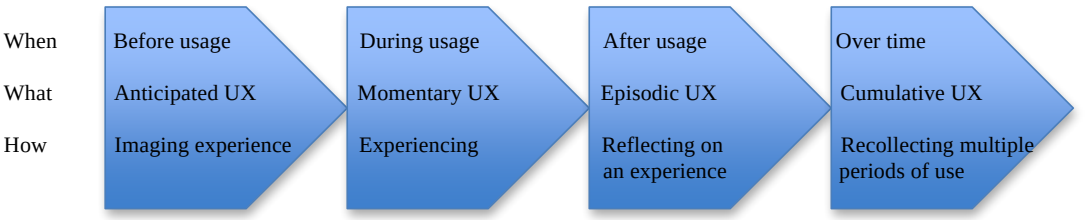

Figure 7. The temporal task of user experience and the internal process taking place in different timespans (Olsson 2012, 22; Roto et al. 2011).

First, the temporal task of UX can be described as an imaginary experience. Second, it can be described as a momentary experience, such as a short-term feeling of space (often sensory, emotional, and internal experience). Third, the experience can be described as an episodic experience that seems to be the assessment of a particular period or activity, which is often associated with utility, the value of the product, or privacy. Fourth, it can be seen as a cumulative experience, which covers the general position as an input to the whole system, after using it for some time (for example, the relationship between the product or service, social impact). (Olsson 2012, 12, Roto et al. 2011) According to Hassenzahl and Tractinsky (2006), situatedness is experienced in time, which is a unique combination of elements of a product or service; it is internal, meaningful, and tied to the situation in which the product or service is used.

In this doctoral dissertation, temporal context can be understood with three experiences, which are past (memories of geocaching trip from past), future situations (planning new geocache trip) and present (for example some of geocachers play Geocaching in only summer time).

Technological Context

The technological context of use focuses on devices, available infrastructure, facts, and system assumptions (Petrelli et al. 2001), sensors (Fogarty et al. 2004), and network services (Winograd 2001). This can be related to hardware, software, or other products (ISO 13407, 1999).

Many the products of virtual environment have made rich interaction possible, supporting collaboration within different activities and user groups. As an example, Manninen (2004) describes the three aspects that enrich the interaction metaphor in virtual environments as follows: *"First, instead of using indirect methods such as menu-selections, and object itself as manipulation is direct. Second multiple and simultaneous input devices are common. Third and finally the input devices used in virtual reality all have high number of degrees of freedom. These three factors are combined together and will lead to applications with high level of interaction"* (Manninen, 2004, 56). Geocaching can be described according to Manninen's categories as follows: First, the GroundSpeak forum does not relate directly to playing the geocaching game, but instead offers a social forum where the players can engage in discussion and voice their opinions. Second, in geocaching events, there is rich interaction between devices and users. Third, the input devices are used in virtual reality at Geocaching.com when users create new caches. After the cache has been placed, it is time to save the coordinates as a waypoint. Then, a unique name for the cache is created. Just as when one enters a waypoint to find a cache, the waypoint is saved in the same format. When a new cache is submitted, it is reviewed for inaccuracies, bad coordinates, and appropriateness before being posted on the Geocaching.com website. According to Manninen (2004), one of the three features that characterize virtual reality is having rich interaction. This is reached through direct manipulation of objects and multimodal devices. However, this technical definition covers only one part of the concept. Rich interaction also affects the social, cultural, and communications components. The point of view in terms of quality rich interaction also requires full attention in the geocaching game (Manninen 2004, 59–60.) In the fifth case study, Ihamäki and Luimula (2013a) conducted a user test with the GeoCentria application, where the goal was to understand the possibility of building a light version of augmented technologies. The mobile phone was used as a platform action game in which the digital compass seemed to use geographical location with GPS. The player received the clues for certain places, where the virtual objects appeared on the screen. In this way, they directed users to find geocaches (P5).

In this thesis technological context can be understood through the devices, software and infrastructure of Geocaching game to tourism and education.

Task Context

The task context describes the specific interaction with mobile multitasking, which relates to a task in the context, for example, of solving a problem prior to finding a geocache (Roto 2006). Brandley and Dunlop (2005) define the functional relationship of users as interactions with other people or objects, which include benefits (for example, resources) and limitations (for example, the need to rush), and a relationship in which it is possible utilize location information. In addition, research on factors related to task context can be identified there it has been divided into current activities

(Smith et al. 2006), work-related tasks (see Agre 2001), and according to the scope or criticality of a task, into primary and secondary as foreground and background interaction (Svanaes 2001). The task context integrates development environments, such as structures, display, search, query, and change management (Kersten and Murphy 2006). Users who want to create new geocaches are always looking for information. In addition, before the completion of a geocache, users need to search for information on the culture, landscape, education, and perhaps some local legends.

Kersten and Murphy (2006) define the task as *"a usually assigned piece of work often to be finished within a certain time."* This correlates with a specific task of players in geocaching to create and share new geocaching experiences. This supports the idea of a mechanism that joins multiple connections, supporting the needs of this task. Kersten and Murphy (2006) achieve this by creating a separate interaction geocaching experience where the object elements are part of an assignment. They use the term in the context of the task to describe the user's interaction with the task. For example, the users may indicate that the activity is related to a particular task to find a clue; this action results in the selection of a Geocaching webpage through the tips that may be included in the task. The Geocaching game is based on task (context) types, for example, solving a problem before finding a geocache. The fourth case study presents the Pierce County Library in the United States having a fake book as an example; to find this, the user must identify a separate cache that contains the number where the book is located. These are hidden all over the United States (Hill 2011, P6). In this doctoral dissertation task context can be understood specific interaction with mobile multitasking in Geocaching game to tourism and education context.

Social and Cultural Context

The social context describes the present situation of the user, his or her roles, and the interaction with a community (Belk 1975). It may also describe other people's impact on the user and the user's social investment goals (Roto 2006), traditions (McCullough 2001), privacy, informal interaction (Grundin 2001), relationship with surrounding people, and the behavior of the people around (Bradley and Dunlop 2005). Moreover, the social context describes the relationship between the dialogue, density, flow, and noise around human behavior (for example, sitting on a crowded train) (Bradley and Dunlop 2005). Researchers disagree on technological determinism, using two approaches. The first approach suggests that communication is located in the social and cultural contexts. The second emphasizes the relevancy of social and cultural habits for the environment (Pearce 1976). Social context includes the culture, the separation of powers, social norms, customs, practices, expectations, and preferences of a group—its current and former interaction (Zack and McKenney 1998).

New communication technologies focus on two-tier technology, first how social structures limit the use of technology in groups, and second, how technology defines the new structures. From this perspective, technology, and new forms and manifestations of social structures, creates and changes the group of rules and resources, while broadening the social structure of the group (Fulk 1993). A key concept in this perspective is the interaction between technologies; between human interaction and social structure, stability and changes are created. New communication technologies such as computer-mediated communication (CMC) systems are often designed to offer new rules,

resources, and innovative features. The Geocaching community has its own social game where users share their experiences with Geocaching community through CMC (Ihamäki 2012b). Existing research suggests that the collective knowledge-sharing group depends on how strong members' ties to the group are, what kind of confidence group members have in each other, and how long the group has been operating (Redding and Wong 1986). The many studies have shown that the results may vary depending on technology, enabling the emergence of new social contexts (Barley 1990).

Social context is the most important factor in all six case studies. All participants want to share their own geocaching experience with other users. *The fifth case study* results suggest that the governing game design makes social interaction among players a key part of the gameplay. Geocaching takes advantage of social factors and creativity by allowing players to have common goals, as well as the interaction of instruments, and lets the players create the playing field. In the fifth case study, one player commented, *"It unites people and helps them understand each other."* This is why I believe that the opportunities for value creation are enhanced significantly for game designers if the concept of personalized co-creation experience is embraced as a source of unique value, which means that the co-creation experience fosters individualized interactions and experiential outcomes (P5).

In sum, the literature suggests that the new communication technologies are located in the social context and structures that affect our sociability and various social and cultural factors. The Geocaching game has reached about 180 countries, in which our understanding of computer-mediated communication has improved in the social and cultural context, and cooperation playing geocaching games and continuously to develop together the Geocaching game content. In this thesis social context can be understood present situation of the user, his or her roles, and the interaction with Geocaching community, or classmates, or geocaching tourist services. The physical, temporal, technology, task, and social contexts of use in the geocaching game and its application to tourism and education has presented the direction of the case studies, which are more deeply described in the next sections.

4.2.4 Case Study 1: Self-Assessment Manikin to Study Students' Emotion in Geocaching of Education

The first case study tries to understand students' experiences of geocaching in education. The goal was to explore the young students' emotional experiences. Creating meaningful experiences in education and special personally meaningful experiences for the individual student is one of the goals of a successful treasure hunt game design. This case used the SAM method, which directly measures the pleasure, flow, and specific station associated with the user's affective reaction to a variety of stimuli. The study was carried out in 2007 on the "Treasure Hunting Included in the Teaching of Geography and History" project. This case study presents the students' experience of using the SAM method, which can be employed to evaluate the treasure hunt education approach according to the students' experiences from the viewpoint of the emotional responses evoked in a usage situation. Battarbee (2004) argues that there is a significant difference in the feelings provoked as part of the planned interaction. This means that we need to understand the UX related to the use of emotions and interaction, as well as specific users in a broad sense (P1).

Participants

In the first case study, the total sample size was 110 primary school students (n=110) from Ruosniemi Primary School in Finland. The students came from 2nd and 4th grade, with three classes for each grade, and were aged 8–9 (2nd grade) and 9–10 (4th grade). The school was located in the city of Pori in Finland.

Data Gathering and Method

The first case study included 110 students of 8–10 years, whose writing and expression skills were not yet advanced. This was one of the reasons for examining treasure hunt games (geocaching and letterboxing) using the SAM method to find out young students' experiences of this method in education. Data were gathered from the students after they had completed five exercises along the Pori Cultural Heritage Road using geocaching and letterboxing.

Lang (1980) and Hodes, Cook, and Lang (1985) established a evaluation instrument called the self-assessment manikin (SAM). This directly assesses pleasure, flow, and dominant position in relation to objects or activities. In this case study, students participated in a treasure hunt event that lasted about three hours to study the local geography and history of Pori. In this case study, students were administered a survey with variations of a smile on a happy figure as a measure of joy; when the smile goes down, it represents a measure of unhappiness. Students could easily evaluate the treasure hunt road because the SAM method is suitable for them to express their feelings on using the treasure hunt game to study history. SAM was initially implemented as an interactive computer program, and was later expanded to include a paper and pencil version for use in groups and large-scale presentations. SAM method has been used effectively to measure emotions in different situations, including reactions to pictures (Greenwald, Cook, and Lang 1989; Lang et al. 1993), images (Miller et al. 1987), sounds (Bradley 1994), advertisements (Morris et al. 1992), and pain stimuli (McNeil and Brunetti 1992). Moreover, SAM has been used with children (Greenbaum et al. 1990), as in this case study, and they were able to report feelings with the SAM method, which clearly helped to validate the research. SAM is an easy, non-verbal method that can quickly assess the UX from the pleasure point of view, allowing the user to report his or her feelings.

Data Analysis

Data was analyzed using thematic analysis of the children's responses according to themes. The sample includes 110 students with five open-ended questions. All data were transcribed and themes were identified. Then, the data were classified, the themes were examined, and the statistical questionnaire data were simplified. This first case study contributed to RQ1, RQ1a, and RQ2.

Pictures 2–3. First case study, students carrying out their exercises (photographer: Pirita Ihamäki).

4.2.5 Case Study 2: Focus Group and Survey to Study Student's Experience of Creating New Content of Geocaching in Education

The second case study used Geocaching as a platform in education, and students made a geocaching series as part of the Pori City National Park exhibition. Students created new content for the Geocaching game within face-to-face interaction in classroom focus group sessions and by using Facebook as a computer-supported collaborative learning environment for the creating workspace. The case study objective was to examine the students' experiences of the city of Pori based on stories on a Geocaching game course and using tools to create a geocaching game for education. Students from the University of Turku in the Degree Program of Cultural Production and Landscape Studies created a Geocaching series called the Pori Hidden beauties geocaching series, which was presented at the Pori National City Park exhibition.

Participants

The participants were from the University of Turku and enrolled in the degree program of Cultural Production and Landscape Studies. From a group of 11 students, five were men and six were woman; they ranged in age from 21 to 40.

Data Gathering and Method

The second case study used focus groups for the natural observation of students' discussion during their creative process. The focus of this case study was a group session in a classroom and on Facebook. This study also collected survey material, including extensive data for the geocaching game and Facebook as a collaborative learning tool. Data gathering was collected after "Pori—Based on the Stories Geocaching Game Course" in April 2013.

This case study was based on 12 hours of focus group sessions, half of which were collaborative learning sessions in the classroom, with the rest of the time spent outdoors creating the "Pori Hidden Beauties Geocaching Series." We had a total of 11 students in the class, divided into groups of three or four. The students spent about two hours generating ideas; all sessions were

facilitated by a skilled teacher/researcher. The aim of the focus group was to identify the students' needs, expectations, and problems with respect to the Geocaching game concept, with emphasis on how students-as-designers appraise the quality of such information. Focus group discussions continued for the purpose of generating ideas, first with students in pairs and then in groups of about six persons. Students wrote different location hints together; some went to look at geocache locations and took coordinates for each site. Students wrote the stories for the geocaching series using the hints previously generated by the group. In the focus group session, students created new content for the geocaching game concept. Due to the tight timetable and limited face-to-face classroom time, Facebook was ideal for the completion of the project (P2).

The goal of the second case study was to investigate students' experiences when in creating the "Pori Hidden Beauties Geocaching Series" via a survey. The survey was sent to the Facebook group with an invitation to students to participate. It consisted of both quantitate and qualitative items. Background information included age, gender, and expectations of the geocaching course. Open-ended questions included giving an example of the student's experience of the "City of Pori—Based on the Stories of Geocaching Game Course" and how Facebook functioned as a collaborative learning tool. The aim of the survey was to understand how to use geocaching in education and assess the implications that creating the "Pori Hidden Beauties Geocaching Series" had for participants and what collaborative learning on Facebook meant to them.

Surveys have been around since 1986, and web-based research since the early 1990s (Kehoe and Pitkow 1996; Sproull and Kiesle 1986). Web-based research facilitates automatic inspection, and response rates can be captured directly from databases. Such software applications can be found, for example, in Survey Monkey, Google Docs, Webropol, and so on. (Birnbaum 2000; McCoy and Marks 2001). In this case study, the web-based survey in Google Docs was used. The study was based on Andrews, Nonnecke, and Preece's (2003) electronic research methods and approaches involving five important quality criteria, namely *the design of the study*, *the participants' privacy and confidentiality*, *sampling and participant selection*, *distribution and elasticity*, and the *pilot survey*. These are the results of a case study on online communities research, which explains how these features can be applied to research in order to reach the active users in online communities (such as in the Geocaching community)—the people who interact with other members by posting messages and sending answers to the public in the community (Andrews, Nonnecke, and Preece 2003).

Data Analysis

In the second case study, interaction analysis was used to perform ethnographic exploration; this is a multidisciplinary method that examines the interaction between people and objects in their environment. Integrated analysis provides a number of useful features to understand the phenomenon of social awareness in an academic environment (Vyas et al. 2006; P2). This second case study includes explorative data analyzed using integration, a thematic analysis approach that objectively and systematically identifies common themes and meanings from the data and further categorizes them at a higher level of abstraction (Rouke et al. 2000; P2). This second case study contributed to RQ1, RQ1a, and RQ2.


Pictures 4–5. Second case study; students find a geocache (photographer: Pirita Ihamäki).

4.2.6 Case Study 3: Online Survey to Study Geocacher's Creative Experience to Tourism Context

The third case study was an online survey using the social interactions and the usefulness of tourism, such as adventure tourism (geocachers) that was actively involved in the development process of creative tourism experiences in tourist destinations. Therefore, it is important to understand the functioning of the creative geocachers in tourism, since there are already millions players. In particular, the location-based experience of creative tourism in shaping geocachers is all the more interesting and an important part of the research. First, geocachers participated only through consumption created by the users to understand their practices and motivation, as viewed through the lens of geocaching, creating tools and applications designed to give users the opportunity to publish their own action-based experiences (Lane 2003; O'Hara 2008; P3). In the third case study, the approach is extended to study the geocaching gaming experience and creativity in tourist experiences through the contents, in which the research focuses on creativity in the context of tourism. The third case study and its empirical findings focus on user needs and behavior, as well as understanding the emergence of creative tourism experiences.

Participants

The third case study included 52 respondents, of which 36 were male and 16 female. The average age of the participants was 37, ranging from 14 to 63 years. The participants in this study were from Finland. Players were chosen randomly by sending invitations to participate using the snowball sampling method in October 2009. Notably, middle-aged people constitute the age group most interested in these games. Player activity indicates how many caches they had previously found. There were 5 participants out of 52 who had found more than 1000 caches and average number of finds was between 200 to 600 caches (P3).

Data Gathering and Method

The third case study's data collection was carried out through an Internet survey, while the second source of information was Geocaching news and applications on the Geocaching.com site. The aim of geocachers in creative tourism experiences is to collect the relevant issues that apply to the experience, needs, values, and expectations of users, and that are related to the distribution of the geocaching community. Special attention was paid to examining the experiences, expanding Geocaching.com news and stories, and increasing the utilization of new research on geocaching in the tourism context. The third case study consisted of qualitative research. Background information comprised nine statements on how the players use the technology in everyday life. In addition, the survey included 22 open-ended questions on the geocaching game, the technology used in the game, tourism, and its features for geocaching. A six-page questionnaire was analyzed (P3).

Data Analysis

Qualitative content analysis was one of a number of research methods used to analyze the survey materials (the survey included a lot of open questions on players' geocaching experiences, and some participants provided extensive text materials). Qualitative content analysis focuses on the language of communication in the content and contexts of text (McTavish and Pirro 1990). The objective of content analysis is to provide knowledge and understanding of phenomena (Downe-Wanbold 1992, 314). In this case study, qualitative content analysis as a research method was defined as the subjective interpretation of the text files (with survey material) as well as the systematic classification process of coding that identifies the themes. The third case study contributed to RQ1, RQ1b, RQ2, and RQ3.

4.2.7 Case Study 4: Online Interviews to Study Geocacher's Creative Experiences along Coastal Road

The fourth case study focused on the interaction of user experiences in a geocaching game as part of adventure tourism. The relatively new tourism area is the combination of tourism services and digital games (P3, P4). The focus of the fourth case study was Geocaching in tourism, as Geocaching offers many opportunities for adventure, sport, and health tourism. The fourth case study discusses how geocachers take advantage from their hobby by collecting creative tourism experiences. This study examined the creative Geocaching experiences from the tourism point of view. In this case, the aim was to evaluate the geocachers' subjective experiences (at a given moment in the geocache locations). The results also describe participants' creativity in producing their geocaches and sharing experiences with other players. Since the users were satisfied with their experience and wanted to share them, it is easier to predict the future consumption of impartial users as this study examines the impact of the user's creative experiences along the Coastal Road in Finland.

Participants

The fourth case study was based on two online interviews by email; the first round of interviews was carried out in 2004, and the second in 2008. The first online interviews included 23 responses, while the second round of interviews involved 3 respondents, making 26 participants altogether. All participants were from Finland.

Data Gathering and Method

The fourth case study was carried out via online interviews by emailing geocachers. This case was based on geocachers' interview material, the Geocaching.com GroundSpeak forum conversations (observation), and geocaching articles from other sources. The data were collected by semi-structured email interviews conducted with 23 geocachers in 2004 and three selected geocachers in 2008; the respondents had all hidden a geocache along the Coastal Road (P4).

Data Analysis

The fourth case study was analyzed by comparing the users' responses with others user experiences and assessing their creative experience of Geocaching. First, I read the transcripts and found the specific themes of the data and carried out the analysis of each conversation's open-ended questions that were identified as involving different answers or themes. Second, I identified the common features of the responses and combined the first encodings of the users' responses related to creative experience of Geocaching. The material contained an analysis of the sources and a literature study after the user experience study. I confirmed that all of the elements and themes recurred and reached data saturation (Krimani and Cambell 2004; P4). The fourth case study addressed RQ1, RQ1b, RQ2, and RQ3.

4.2.8 Case Study 5: Usability Test and Evaluation Survey to Study User Experiences of Geocaching Game

In the fifth case study, our aim was to draw out the underlying theories behind the "experience" phenomenon and the evaluation of the GeoCentria application to extend the scope of the experience game design field. We explored and analyzed how users experience the Geocaching game. Based on this analysis, we demonstrated the core elements underlying the phenomena that constitute experience with the GeoCentria application. Our evaluation framework conceptualized players' experience with GeoCentria application based on the meaning they constructed. This conceptualization provided an understanding of the design and UX of an interactive system. Understanding player enjoyment in Geocaching was expected to provide us insight on user experiences with pervasive technologies in general. The importance of this factor cannot be neglected, as pervasive computing is expected to become an everyday phenomenon in the near future (Jegers 2007; P5).

Participants

There were 17 participants in total, of whom eight were female and nine male. Our participants' age distribution was between 17 and 57 years. The participants came from six different countries, as follows: one from Estonia, four from Finland, three from Holland, two from Japan, four from Poland, and three from Russia. All of the participants had either a bachelor's degree or degree, or were current university students.

Data Gathering and Method

The fifth case study objective was to understand the possibility of building a light version of the technology, and to develop a preliminary theoretical framework for pervasive social games. The device used for the game takes into the direction and angle of the relationship between a digital compass and a geographical location, the purpose of which is to make use of GPS devices. The player is supposed to take care of the geocaches that are offered in certain locations, and provide clues pointing to the objects appearing on the screen with virtual clues to find a geocache. It is also possible to integrate various components (e.g., video, audio, or other material related to a specific location), and the users receive the information and tips to their mobile phones in real time, thereby creating new experiences for the player. In this fifth case study, the user test was held in Ylivieska, Finland. Users first needed to fill out the geocaching application software preliminary survey. After filling out the preliminary survey, users underwent the main test of finding three geocaches around the Ylivieska Centria campus area. After the user test, participants filled out an evaluation form. Since a regular session of the Geocaching game usually takes up to one and a half hours (if no time restrictions are given), we decided to test the users' pre-game concept. During testing, the purpose was to take advantage of technological applications running directly to the testing on the ground, and both the designer and the researcher walked with users of the route, at the same time observing the game concept development (normally with a three-user group) and seeking three different geocaches in Ylivieska (P5).

Data Analysis

The fifth case study utilized content analysis, which focused on user-generated content, or context, and analyzed their meanings (McTavish and Pirro 1990). This case study used qualitative content analysis as a research method for the subjective interpretation of the content of text files and a systematic classification of identified themes. We used content analysis and carried out systematic classification to identify themes of the study. The fifth case study contributed to RQ1, RQ2, and RQ3.

4.2.9 Combining Five Case Studies through the GameFlow Experience Model

Methodological triangulation in this doctoral thesis supported the data collection, which indicates similar problems in the UX of Geocaching and its applications in the context of tourism and education (Table 4). The collected data from all of these case studies involved an evaluation process, where the results were presented as the GameFlow Experience model. By reviewing all of the material and reusing the theme analysis, the data from each study were systematically re-

examined to identify and characterize the users' experience of pleasure, needs, requirements, values, and so on, related to various elements of a Geocaching experience in education and tourism, in context-sensitive cases. For example, various aspects of the case studies resulted in empirical findings. The results from P3, P4, and P5 also described design guidelines. There are various approaches to understanding UX, from the Geocaching and treasure hunt context using the SAM to focus group sessions, and surveys (to increase understanding and create new opportunities for Geocaching in education), to online surveys (to elicit attitudes to geocaching in tourism), usability tests and evaluation surveys (in order to increase the understanding of enjoyment in Geocaching applications), and Testing Apart, Piecing Together (TAPT; for understanding user experiences of Geocaching applications to tourism and education) (Hooper and Rettberg 2011). This dissertation has five case studies and the last publication is synthesis and TAPT evaluate and make a meta-analysis of the case studies this presented Table 5. with compare the this dissertation triangulation matrix (Table 4), which present case studies theory, method, data and research questions, the meaning of the dissertation triangulation matrix deals the impact of the methodological aspects of the study results obtained.

TAPT connects all case studies, evaluates impact of the case studies and surface elements in publication with used methods of the case studies and focuses on the results in the GameFlow Experience Model. TAPT elicits tacit knowledge and latent needs and offers a meta-analysis of the case studies. For example, it has been used to design for real-world experiences that were initially located on the web (such as micro blogs; Hooper and Rettberg 2011). This is divided into two phases, as follows:

1) "Testing a part" was done by analyzing the experiences of the six case studies. I have studied the "surface elements" (from the perspective of the design components such as a case study a physical real-world experience) and "experience effects" (literal results, such as changes in the Geocaching game updates, and abstract results, such as emotional and social effects). The final stage include parts of the elements and their effects and identifies the most important experience, with a written description of the "distilled experience" based on this. This description is not the original, but is instead modified.

2) In "piecing together," practitioners use the description as a springboard to reform the internal experience of the situation. This work concerns five case studies, which with triangulated mixed methods designed experiences in the GameFlow Experience Model, and the analytical phase of TAPT was fit into this goal. This is presented in Table 5.

Case Studies	Component of Experiences	Surface Elements in Publication	Impact of the Research	Methodology of the Studies	Result of User Experience Studies
P1	User experience, player experience, social experience, emotional experience, temporal experience, educational experience, flow experience, narrative experience	- Low technical qualification, all ages can learn to play treasure hunt games, for example Geocaching. - Finding geocaches and carrying out learning exercises. - Using both the physical and digital environment. - Exploring and sharing experiences with collaborative work.	- All five experiential learning activities, including actual experience. Experience is a direct observation in Pori Cultural Heritage Road activities as a basis of knowledge. - The student tests, applies, and puts into practice what has been learned from this experience in new situations, which leads to new experiences.	The first case study used the SAM method, which can be used to evaluate the treasure hunt education method according to elementary school students' experiences from the viewpoint of the emotional responses evoked in the situation, the method suited well for the first case study.	The results included the pedagogical design, where letterboxing and Geocaching offer possibilities for students to interact with the game by exploring a real environment in order to test geographical and historical hypotheses, supported by mobile devices to enhance learners' positive emotions.
P2	User experience, player experience, social experience, emotional experience, temporal experience, educational experience, flow experience, narrative experience	In the second case study, students created a Geocaching series in Pori National City Park and used Facebook as a tool to collaboratively create and share experiences. Students used mobile phones with a measure of coordinates to geocache locations and placed QR-codes in real environments for the geocache places.	The course aim was to create a geocaching multicache that comprised six geocache places all together. The course participants emphasized a conception of the Pori city center with thematic Geocaching series, based on related stories. Students collaborated in small groups for the story, which also hinted at the geocache places.	The second case study used a survey whose aim was to elucidate how to use geocaching in education and assess the implications that creating the "Pori Hidden Beauties Geocaching Series" had for participants and what collaborative learning on Facebook meant to the students.	This course is unique in its use of Geocaching as a concept in education; it uses Facebook as a collaborative learning tool and QR codes to give real environments more digital content, while putting forward the idea of ubiquitous computing. The result suggests that students had pleasurable experiences.
P3	User experience, player experience, social experience, emotional experience, flow experience, narrative experience	In the third case study, geocachers' seeking was carried out using handheld GPS devices or smartphones and the hiding was done by geocachers in their favorite places in the world. Geocachers were as creative as they could in hiding geocaches.	The creative tourist is the typical "pro," engaged in a combination of skilled production. Geocachers get more skill by finding new and different caches. Pro geocachers in the community present new ideas and develop the game itself.	The third case study gathered geocachers for an Internet survey in 2009 and was based on 52 responses. The secondary material was based on geocaching stories in magazines all over the world, linked to the Geocaching.com webpage.	The main contributions of the third case study are increased knowledge of creative tourism, especially geocachers' needs regarding sharing memorable Geocaching experiences, and the new creative tourism services and events created by geocachers.
P4	User experience, player experience, social experience, emotional experience, flow experience, narrative experience	In the fourth case, a set of independent experiences was used to assess geocachers' creative outcomes and emphasis was placed on participants' subjective experiences (their geocache places).	The central purpose of producing creative experience is affecting feelings. The hunt for a romantic landscape has become a whole branch of leisure activity, where the focus is on camera technology to cache special memories for Geocaching.	The fourth case study was based on interview material from 23 geocachers in 2004 and 3 selected participants in 2008 who placed a geocache along the Coastal Road, GroundSpeak forum conversation, and Geocaching articles.	The interviewed geocachers hid their caches at places they consider interesting, places that have personal meanings. The central purpose of producing geocaching creative experience is affecting feelings.
P5	User experience, player experience, social experience, emotional experience, temporal experience, educational experience, flow experience, narrative experience	The fifth case study's aim was to draw out the underlying theories behind the experience phenomenon and the evaluation of the GeoCentria application to extend the scope of the UX game design field.	The result indicated that a combination of pleasurable and fun elements causes a sense of very rewarding, deep enjoyment. In addition, an important precursor to a playful way to find geocaches is to match the person's skills and the challenges associated with the task.	There were a total of 17 participants and a user test session of a Geocaching game that usually takes up to one and a half hours. We decided to test users in a predefined mid-game position. This gave some advantage to the users and was designed with the intention of seeking three geocaches.	The result of the empirical evaluation suggests that participants feel that they benefit from the Geocaching game, which maintains physical health and inspires them to move to different terrains. At the same time, GeoCentria inspires users to research and learn more in the environment.
P6	User experience, player experience, social experience, emotional experience, temporal experience, educational experience, flow experience, narrative experience	From a research perspective, an understanding of player enjoyment enriched the evaluation of the experimental pervasive adventure game and Geocaching applications in several case studies.	The results showed that participants become immersed searching for geocaches, and users have a "wow experience." Game design is thus successful, enjoyment reaches the flow state, and success depends on its continual long-term use.	The sixth case study analyzed the five earlier case studies. The results were presented in two stages, the first describing the evaluation process, where Geocaching plays an experiential role, and the second describing the GameFlow model stages.	The sixth case study's GameFlow Experience model provides guidance in the design of such activities as enjoyment of adventure games, problem-solving exercises, and pleasurable experiences within a game-based mixed reality environment.

Table 5. Testing apart the application of Geocaching to tourism and education.

4.3 Summary

The main aims of this methodological summary were to 1) integrate the methods used in this doctoral thesis, 2) create a deeper understanding of the methodological triangulation of the context, and 3) describe the path for cases in the context of digital culture. The published case studies in this doctoral thesis were examined in the following steps: All articles described the identification of relevant articles in a certain case (see Schwarz et al. 2007). The articles in this dissertation involved selecting and reviewing articles, as well as literature reviews, following filtering of relevant articles in the dissertation and after identifying its content and structure. The next step is to provide a deeper analysis of the content, which will be done in the three following stages: 1) group the components of the theory and empirical evidence on the basis of experiences, 2) constructing and validating the GameFlow Experience model, and finally, 3) concluding the components in the GameFlow Experience model (see Jumisko–Pyykkö and Vainio 2010; Patton 2002; Schwarz et al. 2007).

Picture 6. Geocaches have multiple levels, but creativity is always a key issue in the geocaching game. This is a geocache called Porinoita ja paikkoja Porist (photographer: Pirita Ihamäki).

5 Results: Adventure Game Design in the Tourism and Education Context and the GameFlow Experience Model

The goal of this chapter is to present the results of UX studies on Geocaching and its applications to tourism and education, as well as to summarize them in combination with the work related to the GameFlow Experience model. First, the results of the empirical findings of the geocaching part of education are presented; then, design implications of adventure education are described. Second, the results of empirical findings in the Geocaching part of adventure tourism are presented, followed by an analysis of the design implications of adventure tourism. The first section addresses RQ1 and RQ1a. The second section addresses RQ1 and RQ1b. In the third subsection, the resulting influence on produced factors regarding experienced and related characteristics of the descriptive of experience are presented. This section addresses research question RQ2. Finally, the GameFlow Experience model for the education and tourism context combines the results of this thesis.

5.1 Results of the Geocaching Part of Education

Technological treasure hunt games, such as geocaching, have provided a new pedagogical design, creating an innovative teaching culture. Pervasive treasure hunt games offer students the opportunity to make their own observations and learn things in the environment where they would otherwise read books. On the other hand, the urban environment is challenging and demanding in many ways. It offers the opportunity to take advantage of geocaching in teaching on many different levels. By combining the different themes and innovative teaching methods, students can be motivated to understand better, which leads to better learning results.

The literature review and this dissertation have shown that recently, geocaching has been making its way into education. There have already been several lessons in the world that have used GPS technology and Geocaching to bring about a new style of teaching. However, the use of geocaching in education research has just begun. Geocaching can be beneficial in several areas of learning and experiencing new skills. First, many geocachers have hidden geocaches close to historical sites. Second, to document geocaches, the Geocaching.com site is necessary for the user to write a log about their own experiences with other players. This could potentially enhance their writing skills. Third, some caches are puzzle-solving caches, for which students need to use previously acquired knowledge and collaboratively solve the problem to find the cache. Fourth, some caches require physical activity (like hiking, diving), which could be ideal for a physical education class (Dobyns et al. 2008; P1).

The results of the ***first case study*** with young students aged 8 to 10 years showed concrete experience with all five experiential learning activities, including the actual experience. The students listened to the historical story told by teachers and tried to recognize the clues in the story to find the geocache places. These locations were related to exercises that allowed the students to observe their environment and to perform a task. In the exercises, the students came to look at the environment, for example the church environment, and the teacher gave tips to the students so they

could discover the location of the treasure. Older students were given coordinates on their mobile phones, and tried to find the geocache location in this way. The treasure hunt exists as an "abstract conceptualization" that allows students and teachers to understand the subject of geography and history, transferred to a real cultural and historical environment. When it was a question of a treasure hunt in the optimal "*flow experience*," the students reached a psychological state in which they experienced a goal-oriented activity in search of treasures, whereas nothing else was relevant. This kind of experience was seen as comfortable, and the students were ready to work on their own, without the teacher having to guide them (P1).

The first case study looked deeply at students' *emotional experience* and the students were found to be fascinated by and interested in using treasure hunt methods to learn history and geography. Students experienced the Pori Cultural Heritage Road through the historical story and five learning exercises, through which they had an emotional experience; they were engaged, pleasant, and felt enjoyment in the collaborative *learning experiences*. The first case study gave students the opportunity to have *social experiences* in collaborating together when solving problems like looking for the geocache places. All students obtained *user experience* through moving and playing the geocaching game, especially when finding treasures using their own mobile phones. The students completed five exercises on the Pori Cultural Heritage Road and they had *creative experiences* such as drawing the Old Factory; at the same time, the picture gave hints on what the teacher was asking them to do. The Pori Cultural Heritage Road itself was a learning-by-moving exercise, which gave students a lot of different emotional experiences. The Pori Cultural Heritage road took students about two hours to complete, which gave *temporal experiences* when going through the road and carrying out the learning exercises. Some of the students became engaged in the flow experience state because they were concentrating so deeply on seeking the treasure hunt places, and they wanted to be the first to find them. The Pori Cultural Heritage Road was turned into a narrative, which led to all of the historically and geographically important places. Students had *narrative experiences* through history and geography, moving in a real environment while listening to the teacher's story. The first case study used treasure hunt games as a method and gave students experiences through which they could understand their own environment's history and geography. In general, Geocaching and Letterboxing opportunities that support mobile GPS devices enhanced the learner's positive feelings, despite the fact that the results revealed students were fascinated by the treasure hunt itself. **To summarize, these first case study results showed that students get different user experiences, treasure hunting and solving the exercises throught the history and geography by moving in real environment. This case demonstrated that treasure hunt games increase students' motivation to engage in a learning activity related to history and geography; however, the content of the education can be any subject, for example, physical education, biology, mathematics, language education, and so on. There is a lot of potential when using Geocaching and treasure hunt games on different levels of education.**

The ***second case study*** presented the results of a computer-supported collaborative geocaching series, the "Pori's Hidden Beauties Geocaching Series, which was built via a face-to-face classroom and Facebook social network contexts. In this second case study, students created a geocaching series in Pori National City Park and used Facebook as a tool to collaboratively create and share experiences. This case study focused on creating *valued learning*

experiences, which come from geocaching as a method, the contents of Pori's cultural places, and the students with the "City of Pori—Based on the Stories of Geocaching Game Course." Students created a Geocaching series representing the Pori National City Park area and used it as part of their exhibition.

The second case study was used in geocaching as a platform for education, which connected the main subjects of the Cultural Production and Landscape Studies degree program. The main subjects were digital culture, landscape studies, and cultural heritage (P2). The purpose of the second case study was to create a Geocaching series part of the exhibition using computer-supported collaborating learning tools and innovative techniques to create work, which students experienced in the Geocaching game in education and which is a part of the concept design project (P2). As computer-supported collaborative learning develops and spreads, the efficient use of innovative educational programs becomes more and more evident. This alters the whole concept of learning, including the need for relevant changes in learning, teaching, and being a student (Stahl et al. 2006). The second case study course, "City of Pori—Based on the Stories of Geocaching Game," used Facebook concrete tool to encourage the computer-supported collaborative learning theory. In this case study, Facebook encouraged and created a virtual classroom for the students for a short period of time. Facebook plays to the wider "student experience" of 21st-century university education (Selvyn 2009). Every student presented his or her own individual work and also contributed to the work of the group. Students had the freedom to choose their roles, namely what they wanted to do to create the "Pori Hidden Beauty Geocaching Series." Collaborative working gives students the benefit of being a part of a group, where they can gain trust and earn responsibility. These skills are important nowadays because many workplaces involve short projects that require teamwork.

The second case study results showed that most students gained new experiences and learned from the geocaching game criteria. However, most students thought that the course was a little too short and they had bad temporal experience for creating a Geocaching concept. Students obtained narrative experiences by creating stories involving the Geocaching concept. The results show that students mostly liked writing collaboratively in a small group. Facebook seemed to suit the execution of stories in the Geocaching concept. The results of the second case study revealed that students mostly agreed that using innovation techniques at the beginning of the course was suitable for group work. Group work increased students' social experiences and involvement in co-experiences helped with the creation of the Geocaching concept. Students had educational experiences in the collaborative learning environment on Facebook, and they felt that the collaborative creation of stories was suitable, and at the same time, a motivating tool for them. The course of "City of Pori—Based on the Stories of Geocaching Game" was manifold, and the geocaching game offered students interesting methods (innovation techniques) and gave them creative experiences while they worked together to create the Geocaching series. At the same time, the course made use of tools such as the Geocaching game concept and Facebook, which increased the students' educational experience. The Geocaching series extended Geocaching concepts with QR codes, where students presented historical information about the places and user experiences through a fantasy story, which worked at the same time as a hint for geocache places. Some

students also got the “wow” experience during the course because they found their first geocache, which could lead them to the flow experience state.

To summarize, the second case study, “City of Pori—Based on the Stories of Geocaching Game Course” was unique in its use of Geocaching as a concept, in its use of Facebook as a collaborative learning tool to share ideas and stories, and in its use of QR codes to give the environment more digital content. According to the second case study results, students had an emotional experience (pleasure, surprise, enjoyment), a creative experience (making a new Geocaching series), a social experience, and co-experience (collaborative learning throughout the course), player experience including challenges (creating a game concept of which they had no prior experience), a temporal experience (the course timetable was tight), an educational experience (student learned the Geocaching criteria and worked on projects with others), a narrative experience (students created stories as hints based on certain locations), and a mixed reality experience (the Geocaching road had QR codes and students used smartphones or GPS devices to search for geocaches connecting both the real and the virtual world). On the other hand, we are living in a digital education landscape, which means that we teach students with many different digital devices (smartphones, tablets, etc.) in their everyday lives and who can use them with ease, unlike students in the past. Universities must take this into account and challenge themselves to maximize the benefits of different social media tools in education. Using technology platforms like Geocaching and Facebook (or Twitter, blogs, etc.) in education as a collaborative learning tool brings learning closer to students’ daily lives.

Design Implications of Education

This chapter discusses the research objectives of the concrete empirical results and the effects of different levels of abstracts design. All design implications of education is in P1 and P2, which are summarized in table 6. Descriptions of the experiences in the previous section can be seen as general inspiration when planning objectives for Geocaching and treasure hunting concepts in education, as well as existing applications. Technology is applied to support the treasure hunt adventure games related to education and to create a new pedagogical design, which is when students will have the possibility to observe and learn things by doing exercises. In the first case study, a treasure hunt activity was affected by the local history and geography, which was incorporated in the Pori Cultural Heritage Road. The aim was to bring the students out of the classroom and provide them with new meanings in their local region and use the method of learning by doing the exercises while walking and observing the landscape (P1).

In the early stages of the design of new concepts and ideas, it is necessary to determine the scope, target users, and goals of using the situation. All of these can also be used to design a particular situation. In qualitative UX research, practical design implications are created in the introduction; thus, we offer extensive knowledge consisting of several components of rich qualitative data (Dourish 2004) and try to make practical conclusions relevant to the current situation. The thesis does not offer detailed instructions; the results are guidelines based on the

viewpoint of one researcher (Olsson 2012). Therefore, the following must be taken as sources for inspiration when planning treasure hunt adventure games in education.

1) **Concrete experiences** and experiential learning activities are included in the actual experience. Experience is a direct observation of the function of learning, such as knowledge. When using treasure hunt games and Geocaching in education, geocache places could include learning exercises, for example, regarding local history, geography, or any subject that has a concrete meaning in the environment that motivates students to learn collaborative learning skills and problem-solving skills, and that extends motivation for the subject to learn. This can also be done the other way round: Students could create exercises for geocachers, adventure learners, or adventure tourists, and learn the content themselves at the same time. The concrete experience of a framework represents the extent to which users communicate with others on social media (e.g., geocachers use the Geocaching GroundSpeak Forum bulletin board, chat, local Facebook groups). Many social media sites are designed primarily to facilitate conversations among individuals and groups. On Twitter, blogs, and so on, like-minded people meet to build their self-esteem or to share trending topics (Kietzman et al. 2011). The use of social media tools and conversations creates geocaching games with this content, adventure education courses, or adventure tourist services. The early users able to invest in contexts and friends keep track of the different groups (e.g., Twitter, Instagram). The other online groups can be analogous to real life, open to all, closed (requires approval), or secret (access by invitation only; Kietzmann et al. 2011). The Geocaching content within education usually happens with group work, resulting in collaborative learning processes in the education context.

2) In **reflective observation**, students and teachers reflect on feelings, reactions, questions, observations, and experiences. Reflection is the ability to take a step back, reflect on issues, and evaluate their own experience, which is relevant to other experiences (Hutchings and Wutzdorff 1988; P1). Reflective observation provides possibilities to evaluate one's own geocaching experiences and share knowledge from Geocaching content, which is relevant to other experiences. Reflective observation through the user's identity can often occur consciously or unconsciously as self-disclosure of the subjective information, such as sharing feelings and preferences (Kaplan and Haenlein 2010; P2). Geocaching in the building block framework represents the extent to which the users can determine whether the other user is available. We want to know where the others are in the virtual world or the real world, and whether they are available or whether there is a connection. Geocaching experience occurs directly as a desire to interact synchronously, and this can occur through voice (via mobile or radiophone) or by sharing text (chat, bulletin board, Facebook; Kietzman et al. 2011; P2).

3) **Abstract conceptualization**, such as designing concepts and creating theories, is relevant to current geocaching. Data are transferred according to one's own experience with hypothesis or generalizations. Abstract conceptualization allows the experiences of students and teachers to be transferred to educational plans, in which learning takes place by finding geocaches and doing exercises in geocache locations (P2). Relations with the block represent the extent to which users can connect to others. The flow refers to the user relationships with resources, which are the individual relationships and the way in which these resources are used, altered, or how they change

(P2). The students and teachers need to have good relationships, where they can use different resources in geocaching applications, exchanging ideas or transforming them. Reputation comes from the extent to which users can recognize the standing of others, including within the social media environment. In most cases, reputation is a matter of trust, but because information technologies are not mature enough for such qualitative criteria, social media tools automatically aggregate user-generated data to determine reliability (Kietzmann et al. 2011). Using Geocaching in education, where students create new content in new concepts, is based on trust and user-generated creativity to create collaborative working results.

4) **Active experimentation** includes the tests for the students that are applied and put into practice to form new situations, leading to new experiences. In the active experiment, the distribution represents the extent to which students may change, share, and receive content. Sociability requires the exchange of information between people so that they can deliver solutions. Thus, social media includes students who add material to the education process (e.g., text, video, images, audio, links, location information; P2).

5) In terms of **flow experience**, flow theory provides meaningful opportunities, including new features, experiences, and learning with games that are related to both education and entertainment. Flow is described as activities that refer to the optimal experience. The intention is to use geocaching in education to involve students in goal-oriented activities that produce such an experience. When the experience becomes pleasant, the student may be ready to do something for this reason, and he or she does not care about time or the duration of the function (Kiili et al. 2012; P2).

Table 6 summarizes the expected characteristics of experience arising from and insight into geocaching in education, which influence the GameFlow Model characteristics.

Table 6. Summary of expected characteristics of experiences in treasure hunt game education design.

Description	Experience Characteristics	Aspects Contributing to the Experience of Treasure Hunt Game Education Design (Design Guidelines)
In education context experiences are represented direct observation in learning activities as a basis of knowledge. When using treasure hunt games and Geocaching in education, geocaches could include learning exercises, for example, regarding the local history, geography, or any subject. By turning things to another way, such as offering the students a possibility to create exercises, there are more challenges in the learning and the adventure, with learners or adventure tourists potentially acquiring new knowledge at the same time. The education concrete experience shows that the conversations by which users communicate with others in a social media setting (like geocachers use the Geocaching GroundSpeak forum bulletin board, chat rooms, local Facebook groups).	**Educational experience, player experience, and challenge**	Concrete experience
The students and teachers ponder their emotions, reactions, questions, observations, and judgments related to the experience. Reflection is the ability to step back, ponder, question, and evaluate one's own experiences, then to abstract knowledge that is relevant to other experiences (Hutchings and Wutzdorff, 1988; P1). In Geocaching, experience is tied directly to a desire for interacting synchronously, whether this is through voice or sharing text data (Kietzman et al. 2011; P1). This can be seen as a temporal experience, which can occur once or at a certain time.	**Emotional experience and feedback, Temporal experience, and control in the game**	Reflective observation
The students and teachers need to have good relationships, where they can use different resources in Geocaching applications and exchange or transform ideas. Student and teachers share social experiences in Geocaching games and co-create new content together in a Geocaching community.	**Social experience and co-experience**	Abstract conceptualization
Active experimentation will include the student's tests, applied and put into practice in a Geocaching game as new content. What has been learned from this experience can also be applied to new situations, which in turn leads to new experiences. In active experimentation, sharing represents the extent to which students exchange, distribute, and receive content.	**Player creative experience**	Active experimentation
Flow describes a stage of engagement in a Geocaching activity and refers to the optimal experience. The purpose of using geocaching in education is to involve the student with goal-driven activity and activity that produces a narrative experience so pleasant that the student may be willing to do something for its own sake without being concerned with getting out of this action (Kiili et al. 2012; P2) .	**Flow experience, narrative experience, and clear goals**	Flow experience

5.2 Results of the Geocaching Part of Adventure Tourism

The tourism industry exists to sell experiences to users (Li 2000; Mannel and Iso-Ahola 1987; Ooi 2004; Prentice et al. 1998; Waitt 2000). Hassenzahl (2008) presents the experience of "mode" that meets the be-goals. The term of be-goal mean that user experience has fulfillment emotional responses with user first impression on the product. From the perspective of UX, design can be conceptual, which means a planned search feature that allows the user to fulfill the need to stimulate the keyword-oriented model. Designers usually have clarified goals when designing, for example, geoteaming with another person, which can stimulate pleasure in a geocaching forum (P3).

It is important to understand the functioning of the creative geocachers from the tourism viewpoint, because geocachers' share of tourists is an interesting and important research objective. As a technology for using location-based work that brings different characteristics that make it important to understand the more general notion of location-based computing practices in the tourism context.

The **third case study** used the model of experience triangle and extended it (Tarssanen and Kylänen 2005). In the model of triangle experience can look at experience tourism and tourist's experience perspectives, model has describe specific elements of the product and customers own experience. The experience of the triangle model consists of individuality, authenticity, story, a multisensory character, contrast, interaction, and the motivation to be creative. (Tarssanen and Kylänen 2005, P3). All examples are presented in the third article of this doctoral dissertation. The first element is the *individuality* of experience in this triangle. Individuality in a product means that there is no other product that is exactly the same. Individuality is also used to understand the customer-supplied product. In geocaching games, individuality means, for example, that a geocache can be presented in a unique way online, like hints that are presented through a poem. A geocache location can also be very unique for users, providing them with a different atmosphere in a certain place (P3). Humanities geology is interested in places not just because of their coordinates, but also especially as lived experiences (Kaivola and Riikkinen 2003, 25).

The element of *authenticity* of the experience of the triangle can be understood as a regional model based on location. The authenticity of tourism has to do with creativity. The customer interacts with the product, which determines the authenticity and commercial success, which is one of the most effective indicators of the authenticity of the product (Tarssanen and Kylänen 2005, 138–139; P3). Geocaching was used to advertise the *Planet of the Apes* movie in 2001. Fox Entertainment hid geocaches somewhere in the country United State, which included an incident in the movie and led to www.ProjectApe.com. The first, "*The Devil's Spoon*" was hidden in Mount Diablo, and was discovered by *Ed Hall of Santa Clara*. It contained a metal spoon designed by the director of the movie, Tim Burton. The handle was minded and it came with a certificate of authenticity (Chronicle 2001). The authenticities of the geocaching game are typically represented by local geocache sites that users want to present to others, for example, the beautiful environment from their own point of view. Geocachers encounter different cultures around the world while visiting geocaches in different locations. Authenticity in geocaching could witness users' emotional experiences in the tourism context. Geocaches can take users to locations that are

not generally known to the public. For example, the best geocache places are usually difficult to get to, like extreme geocaches.

The element of the *story* of the experience triangle model attempts to engage all of the elements of the experience and give it a meaning. The story can be seen in the narrative experience of the geocacher's activity; it can create a product of experience, and users can buy it (Tarssanen and Kylänen 2005, 135–140; P3). Geocaching has led to the creation of *Geocacher Magazine*, which is open to users to share geocaching stories, which can also be done on the official Geocaching.com website. One type of geocache is GeoPoll, which is a commercial and sponsored cache. Commercial geocaching caches are used directly or indirectly for their own operations. For example, they may include an entrance fee to places or locations that sell products or services. If the finder is required to go to a business to interact with employees, or purchase a product or service, the cache is considered to be commercial (*Geocacher Magazine* 2008; P3).

The element of a *multisensory* character means that the product could be experienced through as many senses as possible. More diverse sensory content that touches people deeply also leaves a lasting memory (Tarssanen and Kylänen 2005, 141). Geocaching offers the UX in many senses; for example, it offers a chat network where players can chat in real-time and share experiences (Official Geocaching Chat 2011). Geocaching also includes the GroundSpeak forum, which is a bulletin board where users can share experiences. In addition, the *GeocachingLive.Journal* online magazine offers a geocaching game in which cachers can write and publish articles. GroundSpeak Forums provide education related to a site where users can share their thoughts about how they have used geocaching in education. Geocaching offers face-to-face interaction through Geocaching events, while geodating is a cache type where users will have to find other geocachers before they can log on to a geocache site (P3). The use of multiple senses will also lead to flow Geocaching experiences when geocachers want to get into a zone of not even thinking about the time it takes to find the cache.

The *contrast* element refers to different elements of the customer's ordinary life. The product must be different from the customer's everyday routines. Experience is something different from the usual everyday experience, and from another point of view, it can be transformed into something totally different in a different environment. Tourism is the first play with roles of identity and locations (Tarssanen and Kylänen 2005, 141–142; P3). This is well illustrated by extreme caches that take the user away from the daily grind. Extreme Geocaching is one of the geocache types, and for these caches, users need special equipment and special skills to reach the caches. Extreme geocaches offer users a contrast to ordinary caches, special physical and mental challenges, and education experiences.

The element of *interaction* represents the relationship between the customer, the guide, and the other guests. Personal interaction with a tourist guide and a strong foundation to gather information about the physical environment, accommodations, and things to do, see, and experience, and can delight the customers (Tarssanen and Kylänen 2005, 142–143; P3). Geocachers have created a website called *Geocaching Tour Guides* that collects local information about geocaches and from users from all over the world who want to help new players. New players can

meet each other and the local Geocaching clubs can arrange meeting days and events (Geocaching Tour Guides 2011; P3).

The element of *motivation* to be creative is present in the user behavior; for example, when a player acts creatively in a game, this brings about a satisfactory experience, which in turn increases the motivation to play again. The motivation to be creative is born in the community and from other similar games. Users have the motivation to be creative, which is one form of geocaching, because it has given them an active role in the Geocaching community. Geocaching has spread around the world, but the game has also been created around software that extends the UX of expansion. Creative tourism is responsible for the operation of an active, learning environment and the application of this knowledge helps users to develop their own skills (Richards and Wilsson 2006; P3). Geocaching is quite challenging for several reasons. With navigation devices, the creativity of the users to employ them and give each other tips provides opportunities to participate in multiples creative experiences. Creative tourism experience can include a multisensory experience of what travelers are looking for again and again, as geocachers want to create something new.

The results have shown geocachers to be creative and they have brought a new level of experience in tourism, as they are always introducing new ideas to the game for geocache creativity to grow within the community. It is important to note that Geocaching is always included in new technologies, devices, and applications to expand the multisensory experiences. Third case study has present for good example is the snowshoe safari with Geocaching, which will give a new experience to the players. Kildahl (2011) describes snowshoes safari with Geocaching in northern Idaho. Moreover, Anni Love worked in Groundspeak.com, which offers Geocaching.com services for players and companies. She tried snowshoeing via geocaching in northern Idaho. McCaddon, the Head of the Washington State Geocachers Association, also initiated hike-of-the-month (HOTM) excursions designed to access different Artist Points on Mount Baker. He included tracking and communication portals (Twitter, Facebook, Geocaching forums, etc.) so that people knew his location and progress (Kildahl 2011). **To summarize, these third case study results showed that geocachers have overall a wide range of user experiences. The third case demonstrated that Geocaching games increase adventure tourism activities through the game concept; however, the content of tourism can be geocaching events, extreme geocaches (hiking, canoe, diving etc.), or using geocaching as a platform in creative tourism exercises for example in local handicraft workshops. Using Geocaching and treasure hunt games in adventure tourism creates a lot of potential at different levels of tourism destinations and activities.**

Geocaching in the tourism context can also be seen as a holiday point of view, which means that geocachers have temporal experiences within the holiday and tourism context. The results of ***the fourth case study*** present experiences that can be regarded as one of the core matters in travel. The most important traveling experiences are described as being plentiful and these can be compared to personal experiences that relate to geocache locations. For players, it makes sense to see new places and understand different meanings. The results of the fourth case study indicate that people move purposefully from place to place in order to gather new experiences. This means providing experiences to create a framework for new experiences, particularly in products that

allow special experience for customers (Tarssanen and Kylänen 2007). Geocaching offers experiences, moments of success, and the joy of exercise. The fourth case study highlights the comparison of geocaching, bird watching, train or plane spotting, and gathering creative experiences in various destinations. Photos, souvenirs and geocaches, are located in the grey area of tangible and intangible collections. Non-materials in the collections can collect points based on spottings, collecting treasures, or geocaches' qualitative experiences. Creativity is increased, for example, when geocachers called Geocaching Enppu@iloma collect information from different sources and bring them to different perspectives for geocaching. Emppu@iloma created a geocache at Vuojoki Manor, where they told the history of the estate in addition to giving information about birdlife, the park, and the Manor. Emppu@iloma found this interesting and personal, as well as offering a local point of view as a productive description, which is different from the normal tourist destinations presented through texts (Geocachers Emppu@iloma 2008).

Overall, these previous case study results are presented geocaching can create a new meaning of traveling. Geocaching offers experiences, moments of success, and the joy of traveling. As Geocacher Team Perttuh (2004) states, *"Geocaching fits in with our goal to visit all Finnish municipalities and take different roads as much as is possible."* The main result showed that creative experience of Geocaching is sometimes a goal for users when they are searching for geocaches and want to create their own experiences; at the same time, the creative experience of Geocaching is a merit for users who are making a new geocache and want it to be unique. Therefore, the application of Geocaching that produces a specific creative tourism experience is seen as relevant. Geocachers produce new meanings for places and share them with the Geocaching community. Risto Gylden, the Geocaching pioneer, states that *"Geocaching has made travel interesting. While in the past we walked around the shopping streets and museums, now looking for geocaches and experiences"* (Schakir 2002).

The ***fifth case study*** was focused on understanding and designing UX with (or through) interactive systems. Depending on the context and the domain of systems, the goals of UX may vary from supporting user entertainment (pleasure, enjoyment, satisfaction, trust, etc.) through personal growth (challenges, education, etc.) to social interaction (personal connections, emotion, etc.). Player experience in the design field is focused on many experiential aspects (emotions, values, meanings, etc.) related to a technical system, the UX, and usability (Vyas and van der Veer 2006; P5). The results indicate that high-quality interactions that enable individual users to co-create unique experiences within the Geocaching game are the key to unlocking new sources of competitive advantage. The empirical findings present a variety of experiences that users shared in the usability test. In the fifth case study, based on empirical evaluation, participants felt that they benefitted from the Geocaching game, which maintained physical health and inspired them to move to different terrains. At the same time, GeoCentria inspired users to research and learn more in various environments. The Geocaching game offered a new way to present, for example, tourist destinations (P3; P4; P5). In this way, the participants saw that the GeoCentria application will offer new experiences in the tourism business.

From the results and presented analysis, it is possible to say that new social media services could easily add to the GeoCentria application. The participants in the fifth case study liked the idea that the GeoCentria software can be viewed simultaneously by different users. This can be

extended to a challenging social experience if social interaction is the driving force behind the related gameplay. The results show that participants enjoyed the social experience in the Geocaching game. The GeoCentria application works well with friends and general group situations. Social competition is also an important aspect of social interaction; participants get satisfaction from competing against other users. In this case study, we concluded that opportunities for value creation are enhanced significantly for game designers if the concept of personalized co-reaction experience is embraced as a source of unique value. Personalizing the co-creation experience means fostering individualized interactions and experience outcomes.

The fifth case study results showed that the creative experience also equals freedom and allows players to express creativity and the intention of playing the game as they desire (Sweetser and Johnson 2004). The participants indicated that they could create and share their knowledge within the GeoCentria application. The results demonstrated that participants create new ideas, challenging the Geocaching game concept; 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" (user quoted in P5). Using the GeoCentria application and getting information in QR codes provides a natural way to interact in geocaching. One user stated that "The tips with QR codes were easy to use and fun, as well as modern and innovative" (P5). Participants want more competition with groups: "Competition between groups of people from different countries can open new possibilities, it can be a new kind of tourism service" (user quoted in P5).

The results indicate that the GeoCentria application can easily be used in education, and as the motivation is learned from others experiences has the consequence of creating new information, which extends the values of the Geocaching community. The results indicate that participants are able to learn through their experiences and co-experience in finding caches. The results define the emotional experience of the complex construction of the physiological, affective, and cognitive measurements, the core of which is entertainment media (Vorderer et al. 2004; P5). Positive emotional experience will play an important and interesting role in action, and will motivate people who are likely to engage in it. The GeoCentria application motivates the use of Geocaching to, for example, "make a recreational day" (user quoted in P5). The Geocaching game was enjoyable for participants. The players felt in control of the actual movements they explored in their environment (Federoff 2002).

According to the results, combinations of pleasurable and fun elements in geocaching game causes a sense of very rewarding, deep enjoyment and motivate to continue to play geocaching game. In addition, an important precursor to a playful way of finding geocaches is to match the person's skills and the challenges associated with the task. Most of the flow and immersion experience relate to activities that are goal-oriented, bound by the rules, and require mental energy and certain skills. In this case study, participants felt that they were able to find geocaches in stimulating and surprising ways. Participants needed to be rewarded appropriately for continued play; in this case study, participants felt, for example, "*a wow-experience and player thinks to start a new hobby playing the geocaching game*" (user quoted in P5). The effort invested in a geocaching game should be the reward of success (Brown and Cairns 2004; P5). Temporal experience as experience flow starts with first-time use, and its eventual success depends on its

continued long-term use. Enjoyment, as stated in relation to the experience of flow, is self-rewarding and often the ultimate goal of the whole process (Nakamura and Csikszentmihalayi 2002). Participants become immersed in searching for geocaches: “Time flew by while I was collecting geocaches and information” (user quoted in P5).

To summarize, the results showed varying experiences, as listed below, and it has been suggested that a pleasant experiences is elicited for every individual component in the GameFlow Experience model. For example, a geocache may be intended to create a pleasurable creative experience, but this joy does not seem so powerful if the participants do not consider it as being a new experience for them or even unpredictable.

In this doctoral thesis, the results above presented Geocaching as a multifaceted activity that gives users all kinds of experiences. This dissertation examines the underlying theories behind the experience phenomenon and the evaluation of Geocaching applications in education and tourism in order to extend the scope of the experiences to the game design field. Based on the six case study analyses, the core elements underlying the phenomena are provided and these constitute the UX within Geocaching applications.

Design Implications of Adventure Tourism

This section deals with the study objectives through concrete empirical material. It includes descriptions of the experiences commonly used as inspiration for the design of geocaching and adventure game concepts in tourism, as well as in refining existing applications. The third case study described the theory of experience, the triangle model, which provides guidelines for the design of creative tourism experiences. The fourth case study presented design guidelines based on empirical data relating to the themes of geocaching adventure and creative service solutions for tourism. Furthermore, the fifth case study was based on designing adventure game mobile applications in the context of tourism. Design guidelines create a strong sense of the impact that can be a pleasant experience for each of the GameFlow model features. For example, work can create a pleasant creative experience, but this joy does not seem very strong if the thing that participants will be able to create is not perceived as unique, complex, or unexpected (P5). These design guidelines describe participants’ ideas and theoretical conclusions. Next section go throught the P3, P4, P5 design guidelines and end of the section has collected and summarized all guidelines in table 7.

The Design Guidelines of the Third Case Study

1) **Support interaction for sharing experience in the community**

Description: Creative tourism services should support the collective experience and interface with other users, to promote responsibility among users and develop cooperation.
Example: Memorable positive and creative tourism experiences are suitable to be shared with the community using a variety of platforms. It is important to support the creative experiences, quickly

share information about others, comment on and collaborate to modify existing experiences, and interact with the people around.
Motivation: Users will have the motivation to be creative and benefit from positive life-long tourism services. At the same time, the whole community can benefit from the creativity of the users, and they will be able to share and expand the community (P3).

2) **Providing features for multisensory characters' experiences**

Description: Creative tourism services should support the individual and collective experiences in terms of as many senses as possible. All the senses should be in harmony with the natural creative tourism experience. Users participate in order to get the flow of creative tourism experience in the episode.
Example: Users can share real-time multisensory experiences, for example and in particular, the events, and share the experiences of the players who were there. Social media applications provide the opportunity to share blogs and bulletin boards, and to chat about the creative tourism experience by engaging them in connection with the service. Creative tourism needs to be aware of mixed reality services, which is a growing sector and will be the next step in travel technology applications. By connecting the two worlds of the real and virtual, as well as combining them with traditional tourism service results in the production of new digital tourism. Therefore, it is essential to seamlessly integrate creative tourism services accessible to everyday situations and public spaces.
Motivation: Users' motivation level of immersion in the required technology is attached to everyday practices and experiences. As a result, the technology enables the design of actions in a continuous interaction between the communities, which is an important factor in achieving pleasurable experience. It also connects users so that they can easily share their experiences with the community (P3).

3) **Letting users extend the contrast by sharing their unique experiences**

Description: Experience, which is different from the ordinary everyday experience, can be seen from another point of view in different environments. Users can expand the tools that explore a variety of user roles, identities, and places to demonstrate the contrast of creative tourism services.
Example: Creative tourism activities must be in contrast to ordinary life, for example, through application of extreme sports such as extreme geocache (hiking or diving). Creative tourism services include a social recommendation system in which the customer explores the services and places and leave their comments and suggestions for these locations.
Motivation: For users, motivation comes from finding new experiences that they can share with the community. Creative tourism and its applications play an important role, because users want to engage in unique experiences easily and extend them by developing something new (P3).

4) **Supporting the sharing of motivation to become a creative "tool" in communities**

Description: User motivations have to be creative, and the tools should support this. Users have the motivation to use a variety of tools within the community, as solutions give the value of the

community. In addition, users have access to unique experiences shared by the community and the users get their own profiles of respect when someone creates something new and unique (the same can be found in geocaching).
Example: Users sharing their creative tourism experiences.
Motivation: In a creative tour, the operator gives customers the opportunity to develop own creative experiences, for example, by bringing in the services of the design tools. An individual's motivation is being creative, and this will create a positive community atmosphere. Creative destination management and the community itself enable new users to develop motivation and creativity when they have the right tools to engage in a unique travel experience, and at the same time, to share this with others (P3).

The Design Guidelines of the Fourth Case Study

1) **Narrative experience**

Description: Geocachers build their own stories from the premises and examine their own way to support their creative imagination. Ordinary and everyday geocache locations mean that they open up a different experience and different interpretations.
Example: Geocachers create different soft cities in any part of the city; they do not set up their own identity but give free reign to the imagination, making geocaches in sites where people would not go otherwise. Players hide geocaches using creativity, with the help of which they present places to other cachers. The configuration frees geocachers to construct their own narratives about the places and to explore them in their own way, to exercise their imagination, and to be creative. As Raban (1974) presents, individuals construct their soft city from the streets they visit and those they imagine, and this representation is as real as the hard city shown on maps. For example, being with a local geocacher can include a chat over coffee, but also encompasses imagining what his or her life is like (P4).

2) **Creative Experience**

Description: Creative experience is a part of geocaching, because the players want to create more geocaches around the world and show the most interesting experiences to other cachers. Geocachers receive more recognition from the Geocaching community according to how creative they been.
Example: This one of the example of the ultimate Geocaching promise called "Race to the Top." Cachers need to find a chair made of stone on top of a hill. The geocacher can sit on the stone chair and look at the magnificent scenery. They have to look for a cache, however, that is at an altitude of 4400 km and can be found in the stone container of the cache. When the geocachers have found the treasure, they have to pass through a small cave. They will experience a true feeling of success, because the climbing is difficult, and this gives a lot of new experiences to the finders (Super Extreme Geocaching 1.12.2010; P4).

The Design Guidelines of the Fifth Case Study

1) **The tracking system in adventure mobile games**

Description: Adventure mobile games such as Geocaching should support a tracking system.
Example: The tracking system needs to show the past and future routes taken, and users should be able to easily leave messages about geocaches using coordinates. Users can also leave hints to other users on the road. They want to share position information with other users and find other players nearby, maybe even players against whom they are competing.
Motivation: Tracking systems motivate participants to extend the geocaching game into social interaction experiences, especially in the context of tourism (P5).

2) **Social media tools for competing with other players (social networks)**

Description: The adventure mobile game should support sharing information using social media services and competing with others. Games that support visiting tourist destinations benefits from users who create spaces for new content.
Example: Social media services offer a tool that provides groups the opportunity to compete with other groups based on time or the number of geocaches found. Social media tools represent an easily integrated method, both in our daily life and in the context of tourism.
Motivation: Participant success maintains desire for addition social components in a gaming experience. Furthermore, participants wish to use a digital gaming platform to its full extent as an infocommunications platform capable of bringing users together (Baranyi and Csapo 2010; P5). Voribiyenko and Nikityuk (2012) define infocommication as "a set of facilities for the processing, accumulation, storage and transfer in the space of information that are implemented into the entire telecommunication network structure providing the accessibility of information resources and information exchange. An infocommunication service is a multiservice that satisfies the telecommunication and/or information requests of a customer and enables him to participate in the control of the service realization process" (Voribiyenko and Nikityuk 2012).

3) **Mixed reality experience**

Description: Mobile adventure games should support mixed reality components, like showing the player location on the screen, the finding of caches, and players who are near the current location.
Example: Mixed reality components can show player scores, as well as the location of other players. Users want to use mobile phone cameras in gameplay, for example, to take pictures with virtual components (mixed reality screenshots, including scores and hints) and to share them with other users via social media services. In touristic venues, users can create new content by using the geocaching game.
Motivation: Participants gain motivation from mixed reality because its playing field exists in both the real and virtual environments, serving different game functions. In the context of tourism, mixed reality components can provide useful information relevant to the local area (P5).

4) **Educational experience tools**

Description: Mobile adventure games should support educational experience tools. Garrison, Anderson and Archer (2000) has provide for the use of computer-mediated communication with in computer conferencing in supporting on educational experience. The model of community inquiry constitutes three elements of an educational experience, which are social presence, cognitive presence and teaching presence. Social presence is meaning the emotional expressions, open communication and group cohesion in computer conferencing. Cognitive presence is mean exploration as in formation exchanges, integration as connecting ideas and resolution as applies new ideas. Teaching presence is means management defining and initiating discussions topics and building understanding with sharing personal meaning of the topics. (Garrison, Anderson and Archer 2000) Educational experience tool is formed between these tree elements social presence, cognitive presence and teaching presence.
Example: Mobile adventure games could be used as an educational experience tool, which companies can use for functions such as team-building days, or teachers can use in education for any subject. A treasure hunt could be a pedagogical method and provide an experience for users to learn about the environment. Creative tourism involved in creating such an experience could profit from the educational capabilities of such an adventure game. The geocaching game gives the opportunity to players to create their own experiences, and creates new possibilities for sharing experiences with others.
Motivation: The motivation of participants is to engage in a learning experience that enables them to create new information for future social interactions, increasing the value of the community as a whole.

5) **A narrative experience tool for tourism (or any other context)**

Description: Mobile adventure games should support narrative experience. Narratives emerge from the interaction between objects and physical locations.
Example: Mobile adventure games can offer narrative experience around the world. 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. Tourist destinations make narratives of places and stories through their products. Hence, players can create new content for the game.
Motivation: Exciting stories motivate participants, users obtain a description of history from the places or a mystery-story based on the places, which makes them further enjoy the search for new places. Humans are always interested in adventure (based on many studies in the literature); this is why narrative tools support people to gain new experiences.

Table 7 summarizes the expected characteristics of experiences within treasure hunt game design in tourism context.

Table 7. Summary of expected characteristics of experiences within treasure hunt game adventure tourism design.

Description	Experience Characteristics	Aspects Contributing to the Experience of Treasure Hunt Game Adventure Tourism Design (Design Guidelines)
The creative tourism service should support combining experiences with other users, giving creative tools, and managing and viewing them together in a community.	**Player creative experience, emotional experience and feedback, social experience and co-experience**	**Support the interaction of sharing experiences in a community**
The creative tourism service should support individuals and collective experiences in relation to as many of the senses as possible. All sense stimuli should be in natural harmony with the creative tourism experiences.	**Player creative experience, emotional experience and feedback, social experience and co-experience, narrative experience**	**Provide features for multisensory characters of sharing experiences**
The experience of something out of the ordinary enables users to view the self from another perspective, as in a different environment. Users can extend tools, where supported users have different roles and places, in contrast with creative tourism services.	**Player experience and challenge, player creative experience, educational experience, flow experience**	**Let the users extend contrast by sharing unique experiences**
Users' motivation to be creative should be supported with creative tools. Users have motivations to use different tools in communities because solutions give value to engaging in unique tourism experiences within the Geocaching community and users' become more respected when they create something new and unique.	**Player experience and challenges, player creative experience, flow experience, temporal experience and control in the game**	**Support sharing of motivation for creative "tools" in communities**
Geocaches are not dominated by iconic buildings or strong historical or cultural narratives, or by clearly established routes through which they are consumed, despite some considerable efforts in place, as in Puuvilla of Pori in this study. The geocachers construct their own narratives about the places and explore them in their own way.	**Player experience and challenges, player Creative Experience, temporal experience and control in the game, educational experience, flow experience, narrative experience and clear goals**	**Narrative experience**
Sometimes, players need to solve puzzles before they can reach the place, which means that participants are more involved in creating their own experience. There are no caches that are similar because all players also create new content in the game. Creativity is a talent and a value for the player in the Geocaching community.	**Player experience and challenges, creative experience, social experience and co-experience, temporal experience and control in the game, educational experience, flow experience, emotional experience and feedback**	**Creative experience**
Adventure mobile games like Geocaching should support a tracking system.	**Player experience and challenges, social experience and co-experience, temporal experience, emotional experience and feedback**	**Tracking system in adventure mobile games**
The adventure mobile game should support sharing information via social media services and competing with others. Games supporting tourist destination visits benefit from users who create places for new content.	**Player experience and challenges, social experience and co-experience, player creative experience, emotional experience and feedback, temporal experience and control in the game, educational experience, flow experience, narrative experience**	**Social media tools for competing with other players (social networks)**
Adventure mobile games should support mixed reality components, such as by showing the player's location on the screen, the finding of caches, and players who are near the current location.	**Player experience and challenges, social experience and co-experience, player creative experience, emotional experience and feedback, temporal experience and control in the game, flow experience, narrative experience and clear goals**	**Mixed reality experience**
Adventure mobile games should support narrative experience. Narratives emerge from the interaction between objects and physical locations.	**Narrative experience, flow experience, educational experience, emotional experience and feedback, player creative experience, social experience and co-experience, player experience and challenges**	**Narrative experience tools for tourism (or any other context)**

5.3 Results of the GameFlow Experience Model

This section describes the results in the current literature on UX in pervasive game design and empirical findings of six case studies through the GameFlow Experience model. The GameFlow Experience model was created as a result of five case studies and a sixth study combining and synthesizing the empirical findings of the other five. The model is both a result of the empirical findings and a design and evaluation tool for further work. The GameFlow Experience model is a useful tool to understand how users talk about their experiences, what types of experience designers should aim for, and how designers can design for certain types of experiences in geocaching and treasure hunt applications. This dissertation has paid particular attention to the characteristics of the GameFlow Experience model, as well as what types of experiences geocaching and treasure hunt applications should include, in order to understand which experiences should be created for such games and how they are subject to change.

The dissertation has shown that a successful geocaching and treasure hunt application can be identified in terms of its providing a pleasurable and memorable experience for the user. It engages the user in the product or service. When creating a successful product or service, it is thus important to understand users and their needs. Getting users involved in the planning process is important because planning has become more complex, and it can also be seen as a competitive advantage in enterprises. Designers are not afraid to focus on product design; successful design takes into account all the characteristics of user-centered interaction. The capacity for a smooth UCD process is seamlessly understood in the GameFlow Experience model, and the model can be easily adapted to the creation of pervasive games in the contexts of education and tourism.

By understanding the subjective experience and synthesizing it to the official narrative to form pervasive adventure concepts, we can create useful services and experiences. The better we understand user experiences, designers can utilize this information to create pervasive adventures that will improve user experiences and better integrate with their lives. Through such knowledge, perhaps individuals can be assisted to better understand their own experiences via their transformation into pervasive experience services of social value. This thesis has discussed the impact of user experiences with treasure hunt and geocaching applications in the tourism and education contexts, as well as what kind of experiences can be created to support pervasive treasure hunt concepts.

The next chapter provides UX research findings that address in detail the characteristics of the GameFlow Experience model in the context of education and tourism.

5.3.1 Characteristics of the GameFlow Experience Model

The ethnographic data lead to a rich practical experience that researchers can apply to their own plans for using the Geocaching game or adventure games in new concepts. This dissertation describes the evaluation process and presents the results as the GameFlow Experience model based on experiential practices utilized by the researcher and designers, as explored in the fieldwork. In this section describe also how the empirical findings support and construct a GameFlow Experience

model. I believe that these practices are not specific to a Geocaching game, but are instead very common in other pervasive adventure concepts as well. When designers seek to imagine the experience, for example, including a relationship with others (social experience), the physical environment (challenging experience), such as transport, and the experience of flow, the experience consists of searching for the treasure, which can be challenging in an urban environment with heavy traffic (Vyas and van der Veer 2006). The GameFlow Experience model of this dissertation was based on a literature review of UX and pervasive game design that included the subject of flow theory and empirical findings relating to the extend theory of game design.

Sweetser and Wyeth (2005) presented the GameFlow model, where two real-time strategy game reviews were conducted with the GameFlow criteria to investigate design and evaluation related to player enjoyment. Sweetser and Wyeth's (2005) GameFlow model criteria are concentration, challenge, player skills, control, clear goals, feedback, immersion, and social interaction. Federoff (2002) presents three aspects of usability in games, as follows: interface (controls and display), mechanics (interacting with the game world), and gameplay (problems and challenges). The result is the GameFlow Experience model, which consists of the following eight core components: 1) player experience and challenges; 2) social experience and co-experience, 3) player creative experience, 4) emotional experience and feedback, 5) temporal experience and control in the game, 6) educational experience, 7) flow experience, and 8) narrative experience and clear goals. The next sections give an in-depth overview of all eight components of the GameFlow Experience model.

1) Player Experience and Challenges

With regard to player experience, one needs to understand the aspects of forming an enjoyable game to play and give the player diverse range of experiences. The designer produces a certain type of experience in the game. This doctoral dissertation has shown that pleasure is the key experience for users of treasure hunt applications. With geocaching games, users expect to be wowed at times, which is why interesting challenges are also key, such as reaching difficult to find and reach geocaches. Geocaching games have spread to many areas within the mixed-reality game field. Player levels on geocaching games depend on the challenges, skills, creativity, and levels of enjoyment the geocacher reaches on (P6). Adventure games are enjoyable; they must support the player's skill level. If the player can experience the flow of his or her skills, this is the answer to the challenge posed by the geocaching game, and these must exceed a certain threshold. Therefore, the player is required to develop geocaching skills and enjoy the game (Sweetser and Wyeth 2005). In the fourth case study, geocachers considered it interesting to combine new technology with challenging geocaching experiences. Geocaching is a rewarding activity, including the challenge of a treasure hunt, the motivation of physically being outdoors searching for geocaches, and the satisfaction of experiencing new places. The geocaching game has spread to many areas in the mixed reality game field, and the player's level on the geocaching game depends on what challenges, skills, creativity, and enjoyments geocacher reach on (P6).

2) Social Experience and Co-Experience

Social interaction is clearly a strong element to enjoy the game, as people play games in order to engage in social experiences (Lazzaro 2004). Social roles are important in digital games and games are part of the design and the social dimension, which seems to lack theories and models. Games are not appreciated enough as platforms, but bring people with a common interest to this subject (Ermi and Mäyrä 2005a; Klimmt 2003; Sweetser and Wyeth 2005). The fifth case study included social experience and co-experience elements, which support social interaction in game. Specific elements focus on the gameplay, games that create opportunities for competition, community, and connection (Pagulayern 2008). Social competition is also an important part of social interaction. In the fifth case study, participants enjoyed competing and beating the other users. The term "co-experience" was used to describe the experience of a geocacher to create new types of geocaches in terms of how the meaning of individual experiences emerge. This became a part of social interaction and social capital.

3) Player Creative Experience

Creative experience could be understood as something active that supports users' self-development. In creative experience, the users are responsible for actively learning about their surroundings and apply that knowledge in order to develop their own skills (Richards and Wilsson 2006; P3). The third case study presented the Seaway Trail's new GeoTrail "Caching," which opened for travelers in August 2010. GeoTrail is new geocaching road in United State, which includes 10 geocaches on the road. The GeoTrail encourages participants to get outside and experience scenic, natural, 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. Geocachers finding at least 10 official GeoTrail caches in one region can redeem their passport for a free commemorative GeoTrail Coin for this region. This means that the player's creative experience includes a voluntary short or long trip along the GeoTrail Coast, and he or she can choose to collect geocoins or not to do so. Geocachers share experiences on logbooks of geocaches on the GeoTrail and on the Internet, on geocache web pages (P3). In Pervasive games the Geocaching is the game where users have created the body of the game concept. After when users start playing the game, same year few players start to create organization around the game. In Geocaching users role is still most important, because they develop the game in around the world every day by creating new caches. One of the players' goals is to create new kinds of cache ideas. Players can be as creative as they like, and they want to introduce other players to interesting places in the world. In the fifth case study, the geocachers' creative experience was seen as a creative experience flow, which means that a player must exercise a sense of control over his or her actions (P3).

4) *Emotional Experience and Feedback*

Emotional experience is defined as a complex construct with physiological, affective, and cognitive dimensions, and this is the core of entertainment media (Vorderer et al. 2004). One of the primary concerns of game designers is to maximize player enjoyment; in Geocaching game, flow experiences are created from seeking out geocaches. The emotional form bears the subjective

evaluation of the situation in game. This is related to different emotions (e.g., joy, anger, disappointment, disgust, etc.) elicited during interaction with the game system (Vyas and van der Veer 2006). The game developers need to understand the player's and their experiences. Players receive appropriate feedback at appropriate times. During flow, concentration is possible because the task provides immediate feedback (Csikszentmihalayi 1991). Games should provide immediate feedback on players' actions (Desurvire et al. 2004; Johnson and Wiles 2003), and games should reward players with feedback on progress and success (Lazzaro 2004). Most geocachers provide feedback on the caches they find; some have even come up with a more elaborate way to rate them. The level of interaction in the geocaching game depends on the number of interactive instruments used. For example, the geocaching community can be extended from a local bunch of friends and families to across the country and around the world. Interactivity level is significant in the geocaching game; to become a member of the community, it is only necessary to log in and set up one's own account. This is a player's opportunity to provide his or her geocacher name, email address, and the area where he or she is from, a photo or image, and other details he or she wants to share with the community.

5) *Temporal Experiences and Control in the Game*

Players must be able to adequately translate their intentions to game behavior (Pagulayan et al. 2003), and to feel in control of the movements and the way in which to explore the environment (Federoff 2002). The experience flow is temporal, starting with first-time use, and its eventual success depends on its continual long-term use. In the first case study, the students and teachers were allowed the opportunity to express the temporal experience; as one teacher commented, "Treasure hunt day gives students an experience day" (P1). In temporal experience, it is typical that the time has passed quickly, and the usual experience of works is rewarding, so that often, the ultimate goal of the process is just an excuse (Nakamura and Csikszentmihalayi 2002, 90). Active experience is intrinsically rewarding, so that is the ultimate goal in this process.

6) *Educational Experience*

It is important to understand educational experience, because it refers to the internal motivation to learn and protect one's self-esteem, and represents a strong motivator to acquire new knowledge (Bair and Fisher 2005). Digital games are seen as excellent tools for facilitating and supporting situated learning of students (Gee 2005; Prensky 2001; Shaffer et al. 2005; Winn 2002). Many studies of games and motivation have been based on the motivation work of Malone and Lepper (1987), who proposed a link between motivation and learning. More specially, seven factors, which include individual factors, have been postulated to promote motivation. (Malone and Lepper 1987) The individual factors are challenge, control, fantasy, competition, cooperation, and recognition. According to many authors, many of these factors are related to the use of games (e.g., Egenfield and Nielsen 2006; Garris et al. 2002; Prensky 2001).

The fourth case study geocache in Unajanlahti, called Bird Problem, is a challenging geocache, where the player gets to enjoy being outdoors and learn something about birds. Schools can take advantage of geocaches on the Coastal Road for educational purposes and to collect

information on the history and culture of different sites (P4). Geocachers have a strong sense of community and support environmental education. According to Geoaching.com, the project called "Cache in Trash Out" is a continuous and environmental initiative supported by the worldwide Geocaching Community since 2002, when geocachers dedicated themselves to cleaning up parks and other suitable locations around the world (Geocaching.com).

Geocaching has become part of many school programs, because it is easy to teach children using GPS technology and help them to develop the skills that they will need in the future. The one of the example is fourth grade pupils at the Conover Road Elementary School in United State are vicariously traveling the world through four travelbugs that have been released into the wild. This geocaching project is a pilot program developed by teachers Michele Rogers and Nancy Plumfield. In the start of this particular project, four families volunteered to drop off the travelbugs at local caches. Travelbugs are actually tags similar to a dog tag, and each one has an identification code on it. A keychain is attached to each travelbug, and a note on the keychain asks the person who finds the travelbug to move it one cache closer along the west coast. After the travelbugs were deposited, geocachers in the area have found the tags and moved them to other caches, as requested on the tag. The Geocaching.com website tracks the progress of the bugs as the geocachers log the identification number onto the site with the tag's current coordinates. The goal of the project is to enhance the pupils' geography and mathematics knowledge (Morton 2009). In the educational experience, there exists the opportunity to expand experiences into quite many areas of the geocaching game and other pervasive adventure concepts. The geocaching game involves the concept of creating something new around the game and share the educational experience with others.

7) *Immersion Experience*

Flow experience includes immersion and effortless participation, which can then lead to success in everyday life and change the concept of time (Csikszentmihalayi 1991). Flow describes the complete commitment to action and refers to the experience; players will learn how to paint the experience (Csikszentmihalayi 1991). The optimal experience is seen as a psychological space, with a goal-oriented activity, and nothing else seems to matter. Activities that produce this kind of experience are so pleasant that a person may be willing to do something for its own sake (Kiili et al. 2012). Flow experience is very interesting in a geocaching game, as the gameplay and interactions are independent of time and place. In addition, Geocaching combines the real and virtual world aspects of pervasive gaming, as seen in the GameFlow Experience model. Pervasive games should allow players to focus on the virtual and physical worlds without losing too much of the feeling immersed (Jegers 2007). For example, the geocacher could be immersed in searching for geocaches. Sometimes geocachers do not have full awareness of their surroundings when they try to find the cache, and they might feel that they are immersed in hunting for the caches (P2).

8) *Narrative Experience and Clear Goals*

Narrative experience indicates the interaction between objects and physical location. The addition of a narrative to adventure games such as geocaching has a significant effect when it comes to increasing the pleasure, if the narrative is consistent and the player knows to expect it (Sweetser and

Johnson 2004). Mandler (1984) writes that the stories are in the background or the bottom, the structure of which remains relatively unchanged from the negligent differences in the content of the story (Mandler 1984, 22). Geocaching community members give each other ideas to create something new, to experience the positive experiences with others, and to develop something new (P3). 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 (Polkinghorne 1991). Similarly, in geocaching, players introduce geocache places; some places have public well-known stories and some places have special stories based on geocachers' own experiences. Geocachers create their own narrative structure for the game, where each geocache has a unique narrative because different players have their own way of creating geocaches. The story continues with players' own experiences of finding the cache place, which are then published as their own narrative experiences on the geocachers' own webpages. The narrative experience can shift and take on new meaning when we are forced to challenge our thinking during the interaction that has solidified our perceptions, attitudes, and beliefs.

5.3.2 The GameFlow Experience Model of in the Context of Education and Tourism

The games are designed to bring entertainment to the user in an immersive experience of success. Two of the previous sections summarized the main empirical findings related to the practical use of the research results. Here, different properties are summarized and presented in the current applications, as visually summarized in Figure 8. Pervasive treasure hunt games such as geocaching use a database, or the data management is realized by an independent solution (White et al. 2008). While dealing with the game content, a huge amount of data had to be processed in all six case studies. This doctoral dissertation's theory building on the context of use was based on Dubin's (1978) theory, and this model includes the framing, which starts with the user (1), continues to the system (2) (smartphones with GPS, Geocaching software, etc.), and then moves to the context of use (3) where the geocacher plays the game and solves problems (4) and carries out Geocaching activities (5), for example, creating a new geocache. The user accesses the time flow antecedent when he or she starts to do something new in geocaching. The geocacher or user can also choose Geocaching in education or Geocaching tourist services, where he or she will be challenged (6). For example, in a mystery cache, participants need to solve problems together before they find the geocache; sometimes, the mystery can be like a mathematical problem. At the same time, participants get positive experiences because they have solved a mathematical problem (7). A user reaches flow states with context of use, which is divided into physical context (8), task context (9), social context (10), temporal context (11) and technology context (12). The model also presents the central concepts (experience characteristics) in the area, which are flow consequences for users' experiences of pervasive treasure hunt applications in the contexts of tourism and education. Such a descriptive model allows the following: (1) the development of design implications for pervasive games in tourism and education context, (2) the operationalization of evaluation measures, and (3) drawing research questions for future qualitative research and hypotheses for experiments (Olsson 2012).

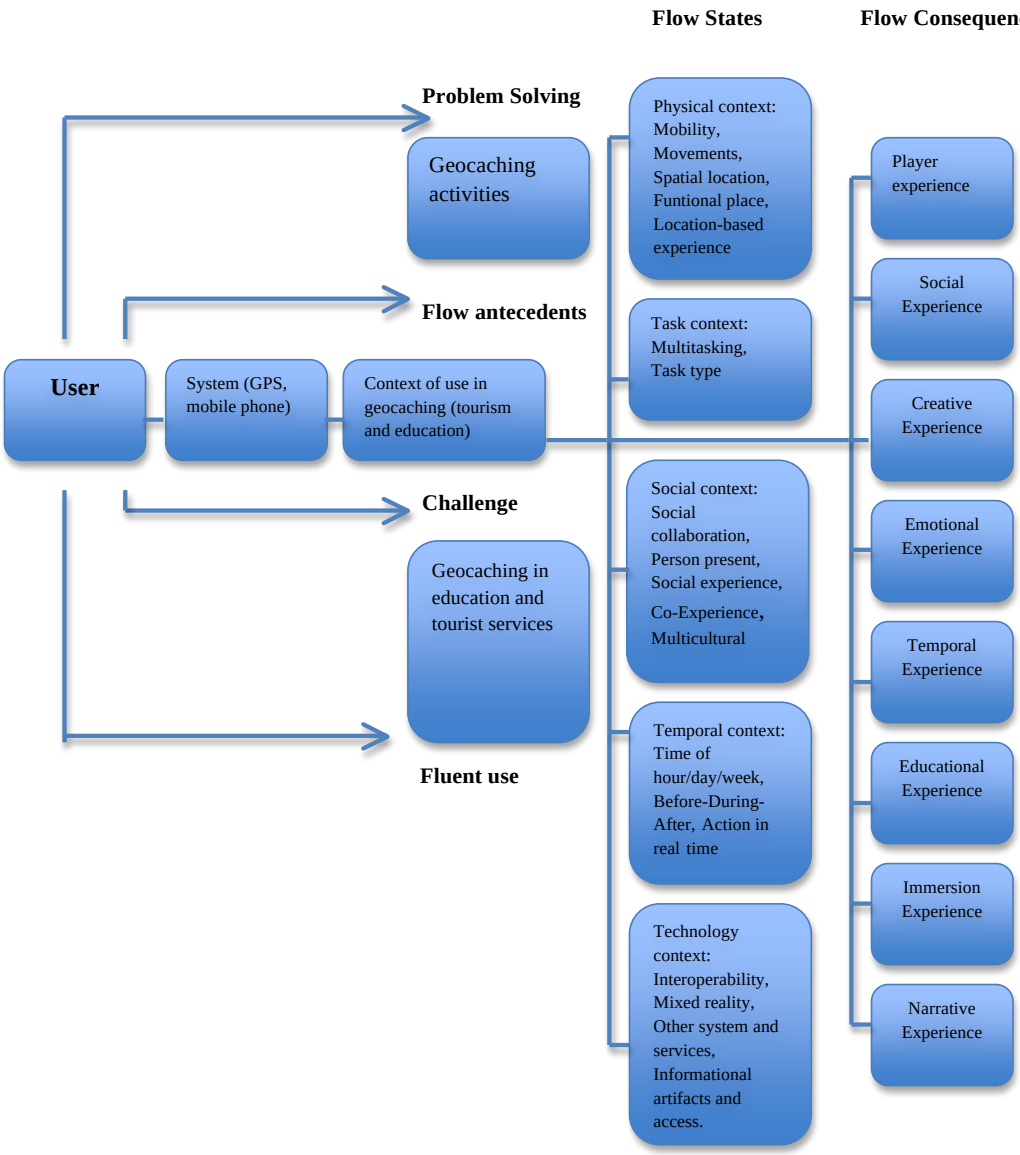

Figure 8. The GameFlow Experience model: a summary of the theories and the context of use identified as influencing the user experience and results of the characteristics of experiences.

All in all, the model summarizes the key theoretical concepts of the discussion in the previous sections. First, it offers the opportunity to increase theoretical understanding of the flow consequences but also to go through the GameFlow Experience model experiences, which propose certain experience in pervasive adventure games in context of tourism and education. This model will draw practical implications in the contexts of education and tourism.

In all five case studies, the central theme is the **user** and his or her interaction experiences with the **system** in the **context of using geocaching games in education and tourism**. *The first case study* discusses users choosing (system) smartphones to play the geocaching game.

This case study describes the Geocaching game system in the educational context. The Geocaching.com website allows users to download geocaches and use them in different applications. The first case study mentioned some applications for smartphones, such as Quo Mobile XT, which is a free digital maps application program that can manage geocaches in a different format. Another application is the Geocaching Intro, which was used in the first case study on the Pori Cultural Heritage Road. Geocaching Intro leads users to Geocaching, and offers experiences to users. It allows access to the three geocaches near the user's current location, and provides a geocache description and tips for the mobile phone to show, for example, the user's location on the map (P1). The third case study described Geocaching from the point of view of tourism. Geocaching is seen as attractive, since it consists of both location—in the real world and virtual worlds (the system works in both). Understanding the diversification of the relationship between the real and virtual behavior is seen as important in the creative tourism experience. Users share their own software on the GroundSpeak Forum and this has a special meaning for the Geocaching community; the geocachers are interested in the development of technology and the potential use of other services as part of geocaching. The GameFlow Experience model covers the context of use.

Users and geocachers play the game, **solve problems,** and engage in **geocaching activities**; for example, geocachers can create new geocaches. Geocaching.com has created Geoteaming to enhance corporate team building with a GPS twist. Teams are given GPS units with preprogrammed coordinates to find. At the waypoints, participants must locate hidden prizes or perform a team challenge. According to the Geocaching.com website, these challenges can take the form of finding a puzzle piece, scaling a wall, or creating a raft to reach the next location; a facilitator observing the team progress has the opportunity to identify group strengths and weaknesses (Geocaching.com/geoteaming, 2.9.2011; P3). Users access the **flow antecedent** as they do something new in the geocaching game. Users could employ geocaching in education courses or Geocaching tourist services, where in the user receives **challenges**. For example, geocachers in Utah have taken the old favorite board game Cluedo and adapted it to Geocaching. "Cloo," adapted by geocacher SirGerald, has GPS-device Sherlock wannabes scouring the Beehive State to solve murder mysteries. Like the board game, clue requires potential puzzle solvers to find the correct suspect, weapon, and location. Rather than using stodgy characters like Colonel Mustard and tired weapons like a candlestick, SirGerald came up with suspects like Jerry Cherry, Poly Pine, and Maggie Maple, and weapons like arsenic-loaded tea, a chainsaw, and a really big stick. Players collect clues at various caches and use them to complete a URL that holds the correct answer (Cameron 2004, 47–48).

Users have positive experiences and playing the Geocaching game changes the **fluency of use**. Users reach **flow states** in certain situations of the context of use. As a result, the context of use can be divided into **physical context** (mobility, movement, spatial location, functional place, location-based experience), **task context** (multitasking, task type), **social context** (social collaboration, person present, social experience, co-experience, multicultural), **temporal context** (time of hour/day/week, action in relation to time, before-during-after), and **technological context** (interoperability, mixed reality, other systems and services, information artefacts and

access). The GameFlow Experience model's context of use is extended to experiences, which are needed when creating pervasive adventure games in education and tourism.

This doctoral dissertation based GameFlow Experience on theoretical and empirical findings, including eight central experience characteristics (player experience, social experience, creative experience, emotional experience, temporal experience, educational experience, immersion experience, narrative experience) to design pervasive adventure concepts in the context of education and tourism. This led users to have **flow consequences**, which every user obtains in geocaching and its application to tourism and education. The flow consequences of UX were positively affected in all eight experiences. At the practical level, flow has been shown to lead to positive consequences, such as increased enjoyment, increased exploratory behavior, and increased use of Geocaching in tourism and education, and positive affect. If designers can develop Geocaching and pervasive treasure hunt games to enhance the opportunities for flow, users will have a more positive attitude toward Geocaching in tourism and education applications, and will be more willing to adopt a new technology that will help productivity. Furthermore, the degree of use of Geocaching and treasure hunt games in tourism and education has been shown to increase when a user experiences flow.

In sum, the GameFlow Experience model is based on theoretical and empirical results and gives guidelines for game designers, concept designers within tourist services, and educators to offer them concrete examples to create new pervasive adventure game concepts in the context of tourism and education. The GameFlow Experience model is created based on the results of the six case studies.

Table 8 includes a summary of the GameFlow Experience model's effects and lists all six case studies. The effects of the GameFlow Experience model addressing to the following essential questions for this study:

1) What: Offering users segments, differentiation;
2) How: Key operations, basis of advantage;
3) Why: Value proposition; and
4) Where: Geographically, virtually, internally, or externally to treasure hunt concepts.

As a qualitative UX study of geocachers, this dissertation draws on the practical design guidelines and provides an in-depth understanding to produce comprehensive research on field of UX and game design. This study aims to create practical conclusions set out in the case studies for the design field, which is one of the researcher's subjective views of the material (Olsson 2012, 81)/ The GameFlow Experience model's implications are combined in Table 8 and Table 9 in relation to central questions of designing pervasive adventure concepts in the context of education and tourism.

Table 8. The impacts of the case studies 1-3 in the GameFlow Experience model.

3) Ihamäki, P. (2012) Geocachers the Creative Tourism Experience. In Journal of Hospitality and Tourism Technology Information, Vol., 3, No., 3., pp. 152-175.	2) Ihamäki, P. (2014) Design of The Pori hidden beauties geocaching series: Computer-supported collaborative web-based learning and sharing experiences. In International Journal Web Based Communities.	1). Ihamäki, P. (2014) The Potential of Treasure Hunt Games to Generate Positive Emotions in Learners: Experiencing Local Geography and History using GPS Devices. In International Journal Technology Enhanced Learning Vol. 6, No. 1, pp. 5-20..		Publication 1-3
1, 2 ,3 ,4 ,5 ,7	1, 2, 3, 4, 5, 6, 7, 8	1, 2, 4, 5, 6	1) Player experience and challenges, 2) social experience, co-experience, 3) player creative experience, 4) emotion experience and feedback, 5) temporal experience, 6) education experience, 7) immersion experience, and 8) narrative experience.	GameFlow Experience model characteristic
The third case study extends the approach of studying geocacher experiences and creative tourism experiences content with research focusing on geocachers' creativity in the tourism context.	The second case study offers students a valued learning experience where students practice project work together on a tight timetable and complete collaborative learning exercises in classroom sessions and on Facebook. In the second case study, students created a geocaching series representing the Pori City National Park area and used it	The first case study offers opportunities for students to interact with the treasure hunt games by exploring a real environment in order to test hypotheses. The result shows that some exercises shift students' motivation on the treasure hunt road, where the education gives concrete experiences and reflective observations about the experience.	**What** - Offering, user segments, differentiation	GameFlow Experience – Model impact
The third case study presents the Geocaching online survey—the implications of geocaching to social interaction and tourism as useful for making small segments such as adventure tourists (geocachers), who are active participants in the development process of creative tourism experience destinations.	The second case study indicates that the experience of collaborative learning in creating a Geocaching series in face-to-face classroom sessions and on Facebook is pleasurable for students individually and as a group.	The first case study presented the pedagogical design of the Pori Cultural Heritage Road using treasure hunt games as a new education tool, in order to teach local history and geography.	**How** - Key operations, basis of advantage	
The third study discusses geocachers' development of creative tourism experience in Geocaching spaces (real life and online) and turn new experiences and applications into positive for the Geocaching community and tourism business. This study brings new scope for the creative tourism field, by which researchers and tourism producers could learn aspects of the users with regard to customers' creativity to use GPS technology for joy, in the geocaching game itself and among many other possibilities around the main activity.	As CSCL developed, unforeseen barriers to designing, disseminating, and effectively taking advantage of innovative educational software became more and more apparent. A transformation of the whole concept of learning was required, including significant changes in learning, teaching, and being a student. This case study involved user locations history in a geocaching game to provide the players with a special story. In contrast to these techniques (GPS devices, QR codes readers, etc.), this study used social networking in the mobile context, by helping each student understand the location around them with knowledge mined from each students location history. Students created five different geocaches.	Students were active participators exploring their own environment through historical narrative, walking along the treasure hunt road and completing exercises in a mobile framework.	**Why** - Value proposition	
Creative tourism experiences in geocaching have reached 220 different countries. This case study had 52 participants from Finland. Participants had travelled in from 100 places to the over 3000 Geocaching places.	A geocache series called "City of Pori Hidden Beauties" was situated in the middle of Pori. The geocaching series belongs to the Geocaching.com webpage and its global geocache series. The geocaches also have their own Travel Bug, which travels all over the world and can be followed virtually through Geocaching.com.	The Pori Cultural Heritage Road comprises five treasure hunt locations, namely the University Consortium of Pori, the Central Church of Pori, the South Promenade, Kirjurinluoto and the Library of the University of Turku. The road is about 5 km long. The last place has a computer with a program, on which students need to enter a code. Teachers have their own webpage, where they can add material about the road.	**Where** - Geographically, virtually, internally, or externally to the treasure hunt concepts	

Table 9. The impacts of the case studies 4-6 in the GameFlow Experience model.

6) Ihamäki, P. (2014) GameFlow Experience Model: Understanding Player Enjoyment in Pervasive Adventure Games. In International Journal of Wireless and Mobile Computing, Vol. 7, No. 6, Pp. 536-548.	5) Ihamäki, P. & Luimula, M. (2013) Understanding the Enjoyment with Geocaching Application, In Journal of InfoCommunication, Vol. V, No., 4., pp. 17-26.	4) Ihamäki, P (2013) Geocachers' Creative Experiences Along Coastal road in Finland. In International Journal of Leisure and Tourism Marketing, Vol 3, No. 3, pp. 282-299.		Publication 4-6
1, 2 ,3 ,4 ,5 ,6, 7, 8	1, 2, 3, 4, 5, 6, 7,	1, 2, 3, 4, 5	1) Player experience and challenges, 2) social experience, co-experience, 3) player creative experience, 4) emotional experience and feedback, 5) temporal experience, 6) educational experience, 7) immersion experience, and 8) narrative experience.	GameFlow Experience model characteristics
The sixth case study combines all of earlier case studies. This study extends the scope of the experience game design field from the GameFlow Experience model. This study explores and analyses how users experience a geocaching game and treasure hunt in these case studies in the context of tourism and education.	The fifth case study draws out the underlying theories behind the "experience" phenomenon and the evaluation of the GeoCentria application to extend the scope of the game design experience field. We explore and analyze how users experience the Geocaching game. Based on this analysis, we provide the core elements underlying the phenomena that constitute experience with the GeoCentria application.	The fourth case study offers users independent judges that are used to assess geocachers' creative outcomes, and emphasis is placed on participants' subjective experiences (their geocache places). The users' own satisfaction with their experience is likely to be a better predictor of future consumption than the opinion of objective observation, I have examined the effect of users' creative experiences.	**What** - Offering, user segments, differentiation	GameFlow Experience – Model impact
The sixth case study presents the GameFlow Experience model in digital games, which was constructed from the literature based on the elements of flow, and the evidence of empirical findings extending the flow experiences in games. The GameFlow Experience model consists of eight core elements.	The fifth case study's evaluation framework conceptualizes players' experience with the Geo-Centria application based on the meaning they construct. This conceptualization provides an account of understanding and designing for users' experience in interactive systems. There is not a large body of academic research on Geocaching in the tourism context.	Geocaching can be compared to romantic landscape photography and collecting experiences. The romantic landscape has become a whole branch of leisure activity, where the focus is on camera technology and photographing competitions, private albums, and geocaches. This is why geocaching can be seen as producing creative experiences.	**How** - Key operations, basis of advantage	
The sixth case study objective in this research is to suggest that the eight GameFlow Experience model components of pervasive adventure concept design may provide guidance in the design of such activities as enjoyment of an adventure game, problem-solving exercises, and social pleasurable experiences within interactive and game-based mixed reality environments.	The fifth case study result indicates that an important precursor to a playful way to find geocaches is to match the person's skills and the challenges associated with the task. Most flow or immersion experiences occur with activities that are goal-directed (as in this case study), as well as bounded by rule and appropriate skills. This study's participants felt that the GeoCentria application offered them stimulation and a surprising way to find geocaches.	The fourth case study result describes the goal of sharing an experience of a place with other geocachers worldwide. Neutral scenery becomes a place of an individual when the place is given meaning or meanings. Interpretation of personal mental scenery is subjective and individual. Geocachers' understanding of interesting places affects their choice of a cache location. It can be said that a landscape is an experience related to place and we are part of that experience.	**Why** - Value proposition	
This sixth case study combines all five studies with 204 participants together. Geographically, Geocaching experiences are global and experiences are gained both in the virtual and the real world. In the future, also mixed reality experiences in Geocaching game will become everyday experiences.	Participants in the fifth case study underwent the main test of finding three geocaches around Ylivieska Centria campus area in Finland. The 17 participants came from six different countries. The user test was administered via mobile phones and related to both the virtual and the real world.	Geocaches can be found anywhere, from distant places in the wilderness to national parks, as well as urban environments. Geocaching can take geocachers to places that are not commonly known to exist. When geocachers have found caches, they see the place through their own internal meaning. The real-time experience of nature is reminiscent of when the first cache came into being.	**Where** - Geographically, virtually, internally, or externally to the treasure hunt concepts	

6 Discussion and Conclusions

The goal of this thesis was to examine UX in geocaching and its application to tourism and education from two perspectives—the understanding of user experiences within experiential components of the GameFlow Experience Model and perceptions of the user experiences in pervasive treasure hunt games in the tourism and education context. This thesis is composed of the results of the five case studies and a literature review. The results were published in six publications and 24 supplementary publications (conference papers and research articles) related to the themes of this thesis. The literature reviews and case study findings defined the frameworks for the problem of the thesis and clarified the concept of the context of geocaching in tourism and education. The case studies were conducted with more than 216 participants altogether in the potential age groups for geocaching applications to tourism and educations. They were conducted in field circumstances using hybrid data collection methods involving methodological triangulation, namely qualitative evaluation and advanced techniques for situational data capture.

6.1 Revising the Research Objectives and Contribution

In summary, the research questions in the doctoral dissertation involved 1) the UX of geocaching and 2) the characteristics of the GameFlow Experience model. The research questions—here, "what" questions—were mainly addressed at the end of chapter 5, which culminated in a model that describes a variety of experiences and characteristics summarized in the GameFlow Model. All six case studies looked at Geocaching and treasure hunt games from different perspectives; however, they were combined together in this dissertation. The first research question of this thesis was as follows:

What kind of experience do geocaching games offer users?

Based on this dissertation results, Geocaching offered the 216 participants in the education and tourism context eight different kind of experiences, namely *player and user experience*, *social experience*, *creative experience*, *emotional experience*, *temporal experience*, *educational experience*, *flow experience*, and *narrative experience*. However, these experiences could be seen as experiences in which the user became familiar with playing pervasive adventure games in the tourism and education contexts in general.

The second research question was as follows:

What are the characteristics of experience in the GameFlow Experience model?

Based on comprehensive review of the literature on UX and game design, the manner how the elements of experiences create meanings for pervasive adventure games. The GameFlow Experience model in pervasive games was constructed from the literature according to the elements of user experiences and the evidence of empirical findings (five case studies), which extended experiences in games. The result was the GameFlow Experience model, which consists of the

following eight characteristics: 1) player experience and challenges, 2) social experience and co-experience, 3) player creative experience, 4) emotional experience and feedback, 5) temporal experience and control in the game, 6) educational experience, 7) immersion experience, and 8) narrative experience and clear goals.

Finally, the contributions of this thesis are recapitulated below.

- This doctoral dissertation is highly topical because of the novelty of both the concept of UX of Geocaching games and its applications in tourism and education. The research is a pioneer study due to the contextualization of UX research in this emerging field of geocaching, but also because of the research focus on game design.
- The result of the GameFlow Experience model is a comprehensive synthesis with regard to the hybridization of various aspects of UX and pervasive game design within adventure games. The GameFlow Experience model presents and clarifies various experiences; it provides them in a real-life context, offers desirable design targets to utilize in service design, and gives a perspective to consider when evaluating the success of pervasive adventure game concepts. The model name GameFlow Experience describes geocaching games well, because players like searching geocaches all over the world and have new experiences again and again. Players get game flow experiences when they search for geocaches, or even sometimes when they create geocaches. The treasure hunting experience is unique to each player, and they want to share this with other players. This is why the game continues to grow and change.
- The design implications for adventure, education, and tourism can help the early concept design, both in future and current applications. The methodological selection was based on UCD and culminated in the subjective evaluation of UX in geocaching and its applications to education and tourism (P6).

6.2 Methodological Discussion

This section presents the results of the used methods, which examined UX of geocaching applications in tourism and education. First, a framework is presented to build up a holistic understanding of geocaching and the factors contributing to the contexts of education and tourism. The goal of the review was to understand the main characteristics of the context of use for playing geocaching. The mixed method for qualitative evaluation in the context of use is composed of 1) the process, including planning, data collection and analysis; 2) understanding the factors that surround the context at the macro-level (high-level features of whole situation) and micro-level (situational); and 3) the use of several techniques throughout the study. This dissertation gives detailed presentation of the methods used in order to minimize any threats involved in qualitative research (Jumisko-Pyykkö 2011, 77).

Any method has limitations and weaknesses that need to be assessed in the design of the research. In addition, the theoretical and practical conclusions must be presented (Olsson 2012,

86). As a term, the *credibility* of qualitative research (Lincoln and Guba 1985) has been replaced by the *internal and external validity*, which is most often used in experimental, quantitative studies. Credibility represents the coherence and harmony based on the findings and theorizes the empirical qualitative data. However, another aspect often evaluated in qualitative research is ecological validity, as in this dissertation, where the methods, materials, and research respond to real-life situations. In this dissertation, external quality is a result of combined user experiences of geocaching game and the system (GPS-devices or smartphones, Geocaching software), while quality in use is pleasurable, surprising, and results in user satisfaction in the performance of geocaching tasks (creating geocaches, searching geocaches) in the real environment. External measures can be used to validate the internal quality to create new content in the Geocaching game. Quality in use measures the degree of excellence, and can be used to validate the extent to which GameFlow Experience model to design geocaching tourist services and geocaching as a method in education are used and meet the user's needs. Appropriate internal attributes of the user experiences, as well as appropriate external evaluation of the GameFlow Experience model, are prerequisites for achieving quality in use. In this dissertation, the Geocaching game in real environment (with GPS and smartphone screens) are relevant to the participants, thereby increasing the ecological validity of the results. Moreover, the five different case studies and the increased amount of interaction time gave participants the opportunity to build up a reasonable experimental basis for their perceptions and judgment. The following section summarizes the methods and discusses all of the articles attached to the dissertation in order.

The first case study had some limitations, particularly in terms of the ecological qualifications. The participants were 110 young students, and they had challenges when it came to answering to open-ended questions and representing their experiences. Consequently, the students' experiences might have been richer if I been able to interview all of the participants after their experience. However, the teachers had an active role and they taught by using geocaching as a platform for local history and geography, which went surprisingly well. The reason for this is probably because the teacher was familiar with the students and experienced in treasure hunt games, even though the education represented the first of this kind of experience for all 110 students.

Second, the participants were mostly from Finland. This might have affected what kind of UX was expressed, the type of experiences users expected of Geocaching as a platform in education or tourism, and what aspects were considered to affect the overall UX. However, with regard to statistical interference on the Finnish and other cultures, there are no proven differences. This became obvious when comparing the third case study results with the fifth case study results, which were marginal compared to the participants' technological orientation.

Third, theorization of the characteristics of experience through the geocaching and treasure hunt games in the multifaceted field of education and tourism is challenging. This subject has been studied and presented in various degrees and disciplines, such as the user's consent or customer value selection. Focusing on UX is a novel perspective in this theoretical background (Olsson 2012, 88). This doctoral dissertation is based on experiential research on UX of geocaching applications in education and tourism. However, this may guide the analysis of the narrative and leave out other experiences, which would limit the completeness of the framework. Still, the perspective of students' experience needs to be researched, and we need to gather the needs and

desires, as well as the requirements. However, the uniformity created a theoretical framework in which there was the utility of providing the design objectives, priorities, and experiences of the use of geocaching, and to provide practical solutions for education and tourism related to the desired type of experience. In addition, characteristics of the experiences were analyzed and identified that were dependent on the subjective interpretation of the researchers. The researcher always has the foundation of his or her understanding of the world, in this dissertation, the kinds of features users can exhibit in the experience of geocaching, which may impair the identification of diverse experiences.

The strength in this approach is that all five case studies were combined and evaluated in the sixth case study. The cross-analysis phases in the sixth case study were relevant in reconsidering UX theories. Finally, measures of internal reliability were successfully utilized in the analysis of actual experiences in all six case studies.

6.3 Directions for Future Research

Christopher Columbus was the most well-known navigator, taking the next step and crossing the ocean. This doctoral dissertation has taken this pioneering step to a new area, namely UX of Geocaching and its applications in education and tourism. This dissertation gained a new understanding of geocaching as useful in education platforms and tourism services, which may in many ways be designed in order to promote various forms of engagement. On a personal level, the research has contributed to my knowledge base as Schön describes; in a way, the implementation was already built during the research process. This is reflected in the study, from which the users will gain and use insight as they participate in creating knowledge during the research process (Heljakka 2013, 468; Schön 1983, 324). In this thesis, we have learned much about UX of geocaching and its applications in education and tourism, both on a theoretical and an empirical level—the results synthesized user experiences at the theoretical and empirical level in order to build the GameFlow Experience model. This is the first step in examining UX as part of the geocaching phenomenon, but I hope that what I have done in the context of this thesis has inspired the reader to become interested in the knowledge and development of adventure treasure hunt games in a different context.

Theoretical Consideration: An Improved Understanding of User Experience in Geocaching and Treasure Hunt Games

New user experiences expand the role of the user to become an active participant whose emotional mode transfers into a desire to have more involvement to create his or her own experiences. The mobile HCI studies of the UX context of use highlight its dynamic and heterogeneous nature, even if it does not list Geocaching in tourism and education. The multifaceted nature of user experiences can be seen as a phenomenon for a field of study or practice (Roto et al. 2011). As this doctoral dissertation claims to understand UX in relation to the geocaching phenomenon, the context of use is important in framing the relevant factors for UX from a broad view of Geocaching in education

and tourism. The results of this thesis are presented the published case studies, examined through the following steps: All publications described the identification of relevant issues of UX of Geocaching (see Schwarz et al. 2007), being 1) selecting and reviewing publications and carrying out literature reviews; 2) filtering relevant articles; and 3) identifying content and structure. For deeper analysis of content, a further three step were taken, namely 4) grouping according to the components of experiences, 5) supporting and validating the GameFlow Experience model, and 6) offering conclusions related to the components of the Game Flow Experience model (see Jumisko–Pyykkö and Vainio 2010; Patton 2002; Schwarz et al, 2007).

Geocaching extends technologically related recreational services. At the same time, new challenges and opportunities have emerged for landowners and developers. Tourism managers and landowners can utilize Geocaching for tourism purposes, such as via the utilization of natural areas (forests, fields) or empty buildings. At the same time, the population has moved to the cities and the countryside is empty, and Geocaching can provide a solution for this by making use of these regions for tourism. This will bring benefits and have a healing effect on individuals, groups, companies, and society. Geocaching has grown to a huge game and inspired users to move in the natural and urban environment. This has increased fitness and reduced heart problems among the players. Geocaching has brought about awareness of diabetes and inspired individuals to exercise through hunting for treasures. There is a "Unite for Diabetes Travel Bug Challenge," where the International Diabetes Association and Merck launched 20,000 Unite for Diabetes Travel Bugs. Each Travel Bug is to reach a designated city and then circulate throughout that city's geocaches, spreading diabetes awareness on the way (Wartburg 2007). UX of the Geocaching phenomenon will be explored in near the future in other contexts, such as wellness and health sectors. I would say that geocaching is more than game, because it can take advantage of health-promoting as a service, which can be compared heath investment, aimed at maintaining good health and well-being of the population.

Overall, UX of Geocaching and its applications in education and tourism took its first step in this research field. Conducting this study and reporting the findings included the many dimensions of user engagement with Geocaching, and this has contributed to understanding this phenomenon. From the beginning, it has been clear that geocachers' motivation for game development is first and foremost a reason to study its possibilities for development in other contexts. As the results show, Geocaching has taken a place as a platform in the digital education landscape. In tourism, geocaching has just begun, as the official Geocaching.com webpage launched the "Geocaching in Tourism" sub-webpage in 2013. Research on Geocaching in tourism has just begun and will continue in the future, and will become relevant to a lot of business areas.

Pragmatic Considerations: Designing for Tomorrow

This doctoral dissertation has aimed to benefit the field of UX in game design. This chapter highlights the implications for future of Geocaching and the pervasive treasure hunt concepts. When we design a game, it is not the case that it should bring us only pleasure. The main purpose of a UX study is to understand what aspects constitute the enjoyment of playing the game, what kinds of experience the game can provide, and how to design something that makes a certain type of

experience at that time (Korhonen et al. 2009). Learning from the findings of this thesis, experiences from the Geocaching game can help in designing a certain type of experience. UX must be designed to be entertaining and engaging with regard to Geocaching in the contexts of education and tourism.

Designers need to understand creative experiences in their own development process when creating pervasive treasure hunt concepts; this seems to be one of the important goals of Geocaching games. In addition, collaborative creativity can have the goal of seeing how different people will create such different ideas. The creative experience user has an active role because he or she is involved in his or her own experience. This can also lead to flow experience, which engages in an activity and turns the experience optimal (Kiili et al. 2012). As the results show, the meaning of the flow is to give users the "wow experience"; in this thesis, the Geocaching game participants also needed flow experiences, which engage the users in the game concept.

In the UX of Geocaching game culture today, a significant six million players are already sharing their user experiences and social experiences through the game. The idea of sharing the UX of Geocaching can be seen not only in the Geocaching.com official webpage, but also in the physical geocache places; however, this sharing has extended to many media. Social media such as Facebook include many local geocacher groups. The Geocaching game is based on sharing user experiences for other players. The conclusions for practical applications are thus that designers need to consider possible ways for users to share and create experiences.

Future Directions

This doctoral dissertation is a pioneering work on UX related to Geocaching and its applications in education and tourism. It has opened many research questions for the future, because this is a first step in this field. The case studies and examples from the world have demonstrated real usefulness and experimental value of Geocaching in education and tourism. We still need practitioners interested in education and tourism in order to achieve the expected results. The thesis presented the following aspects, which can be studied, as well as approaches that can be utilized in future empirical studies of UX in Geocaching and its applications in education and tourism.

First, it would be interesting to study the long-term user experiences of users/teachers that would employ the Geocaching platform in the context of education, for example, during one year of geography lessons. Then, it would be interesting to see how students' experience evolves during this time and why this occurs. I would be interested to examine how students engage in Geocaching over a whole year and learn a subject that would otherwise be learned in a classroom. According to Burns (2013), there is more potential for research on Geocaching with adult learners, which was done in the second case study here. This study has shown that Geocaching in education is suitable for any age group, and the creativity only depends on the person who has made the course.

Second, it would be interesting to research the users'/customers'/players' experiences on behalf of different companies who use Geocaching in the tourism business and to see which kind

of experiences are found in the research, for example, real-time experience in the mobile context. Geocaching is played in many countries, and the game potentially has great importance for the care of the natural environment and opening new promotion for tourism industries and the local economy. This is beneficial for adventure tourism, not just for the tourist or the local economy, but especially for the beautiful landscape preservation and preservation of places we did not even know to exist for the tourism business. The geocaches in certain places and the culture of people who live in these places will also need to be preserved and valued in the game concepts and tourism.

Third, a qualitative approach to the GameFlow Experience model took advantage of a research-oriented approach, and a special focus was targeted at expanding the experiential education level in the tourism industry, especially in real tourism companies. In this kind of research, for example, cultural background and other criteria for potential users could be added, particularly the effects of design solutions or the special impact of the experience, which would also allow statistical conclusions. In the future, it is essential create a theory of UX in pervasive environments by using treasure hunt games in the context of education and tourism.

This doctoral thesis represents kind of a walking tour of Geocaching sites, a neighborhood scavenger hunt that provides innovative methods and tools for tourism and education. This thesis created the GameFlow Model to design new pervasive adventure games for the education and tourism contexts. The markets only wait for new potential adventure games in tourism and education business. Finally, the submitted theories, design solutions, and practical examples offer new information and help to understand the elements that are important in designing and evaluating design methods and the solutions in gathering user experiences. I will conclude this thesis by asking: What kind of pervasive adventure games, such as Geocaching, we will see in the future in the context of education and tourism?

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