Designing an Urban Adventure Gamescape: Avoiding the Pitfalls in Creating Opportunities for Learning Through Location-Based Games

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ABSTRACT

This paper reports on the design and evaluation of player experiences related to a Location-Based Game. Location-based games (or LBGs) seek to move gamified play into the "real world" of cities, parks and other locations. These games are played in everyday places, where game information is tied to specific locations (Magerkurth et al. 2005). This connection to real-world physicality makes the game experience multidimensional and fun for players of different ages. Yet, to be able to envision and create an urban gamescape means that a set of criteria is met. The unique challenge of creating and orchestrating location-based game experiences requires a certain sensitivity of its designers to multiple factors that must be considered. These may include but are not limited to factors such as the city infrastructure, flows of urban traffic, maintenance of recreational areas and human-related factors such as cooperation with the city administration.

The game introduced in the paper represents an urban game adventure built upon the platform of geocaching. We approach the game with a focus on its potential learning affordances. We ask how the pitfalls in creating opportunities for learning through location-based games could be avoided, especially when designing pedagogic aims into an urban gaming experience fit for school-aged children.

Keywords: Urban Adventure Gamescape; Location-Based Games; Educational Game; Geocaching; Game-Based Learning.

Introduction: Location-based Play in a Gamified World

Location-Based experiences aim to provide the user with a richer experience that extends across a series of locations. They build on three core technologies: mobile devices, wireless networking and location sensing (Benford, 2005). Our research focuses on the design and study of a pervasive and location-based game, Sigrid-Secrets. The paper introduces the geocaching trail enhanced with visual

artworks and playified with further with a narrative and mini-games of semi-fictional nature. The paper reports on the design and evaluation of player experiences of this urban game adventure.

Our presentation tells the story of Sigrid-Secrets, a geocaching trail designed and created by the authors (as designers, content developers and researchers), which is located in the cityscape of Pori, a coastal town in Western Finland. It combines geographical locations of a city park with a narrative structure. Sigrid-Secrets is designed to be an easily accessible, narratively engaging and educational experience for players of all ages. The geocaching trail requires its players to move along in the central park areas of the city, visiting six photographic art works prior to the actual geocache. In this way, we have both enhanced the gaming platform of geocaching with art, and also gamified an art exhibition featuring six small artworks 'hidden' in the park areas.

The game offers its players the short-term goal of completing the trail by walking from hidden artwork to another until one finds the final cache. The activity requires the players to walk an approximately 1 km trail from one end of the park to the other end. There is no time limit to compete the trail. Instead, it is the narrative of the character of Sigrid that evolves at each of the artworks, depicting Sigrid at different activities such as dancing or drawing. Engaging tasks are given to the players at each artwork as they are asked to solve easy trivia questions or riddles, such as Sigrid's middle name. While solving these tasks does not give the player scores, they are part of the narrative that intertwines Sigrid's story with facts of the city. By finding the artworks one by one, the player advances on the trail to finally arrive at the actual cache, a hidden container that features the physical log in which geocachers are meant to write their entries.

The objective of this paper is first, to present the aims and designed affordances of our urban geocaching trail enhanced with artworks, a game created for both entertainment and learning. Secondly, a description of the execution of this trail and the play tests conducted with different age groups is given. Focus is given to how the geocaching game relates to and is structured based on its geographical location, a small cityscape. Moreover, we will concentrate on discussing content-creation that is built up on historical and present facts of the city, as well as creative components in reference to how the content is communicated to the

players through the game design. We will then go on to suggest some guidelines on what to consider when designing for urban game adventures with potential learning goals in mind based on our knowledge of the pitfalls we detected while conducting the playtests.

Design Goals for Sigrid-Secrets

"Player engagement and immersion in games is essentially performative and participatory and occurs in a direct result of active involvement, attention and interaction" (Carrigy et al. 2010). Sigrid-Secrets was originally launched as one part of an outdoor, urban art exhibition, *Kätketty Taide* (in english 'Hidden Art'), located in the city parks of Pori, Finland in May 2016. The idea of the exhibition was to hide artworks in non-obvious locations in the park, such as in and under trees, stones and permanent structures in the parks – park benches, electric cabinets etc.

We understand our game as a casual experience. According to Kultima (2009) to design casual game experiences, is to design experiences in a wider experiental context. Design values related to casual games, are, according to the author acceptability of contents, accessibility, simplicity and flexibility. The first one of our design goals would be the simplest and most easily executed both from the design and play perspectives – to use the platform of the internationally known and popular geocaching game and to enhance it with six artworks telling the story of little Sigrid – a contemporary doll accessorized to look like a historical character from the end of the 1800s but depicted in scenarios that are known to children and adults of the 21st century. The audience for this game would be primarily those with an interest and previous experiences in geocaching. The prerequisite for playing this game is to have access to the Geocaching.com app on one's smartphone.

Designing for Casual Play

What we had in mind for Sigrid-Secrets was to design an acceptable, accessible and in this way *casual*, yet rewarding game adventure for different ages of players, with different dimensions of game play. In our case 'casual' follows in part Kultima's suggestions, that our game is acceptable, accessible, simple and flexible, as described below:

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Acceptability

We strived for acceptability. For instance, the acceptability of our game withholds possible instrumental dimensions, when the game is considered as a tool for learning, supporting light mental or physical exercise or facilitating social interaction. These potential dimensions of the game adventure have been scrutinized in earlier phases of our research (see e.g. Ihamäki & Heljakka, 2017; Heljakka & Ihamäki, 2018) and we continue to develop our work on the opportunities for learning in this paper.

Accessibility

Our goal for accessibility meant that Sigrid-Secrets would be easily accessible cognitively: We connected the narrative of little Sigrid with facts of the history of Pori by exploring the collections of the Satakunta Museum, then giving the character a semi-fictional personality (her name is based on a real person who lived in the region in the 1800s) and designing her fictional narrative partly based on this information. In this way the story of the game became relatable to local people, as it has a straightforward connection to the city where the LBG is located in. Other points regarding the accessibility of the game include the concise information given in the adoption phase: The Geocaching.com website dedicated to Sigrid-Secrets informs the players of the 'backstory' of the character.[1]

Simplicity

Another design goal for our game was to keep it simple considering both its acceptability and accessibility. Simplicity as a design guideline partly overlaps, then, with the other design goals, but it refers in our case also to the simplicity of the user interface of the mobile device, typically a smartphone which through the use of the Geocaching app unlocks the coordinates needed in order to find out the exact locations of the artworks along the geocaching trail.[2]

Flexibility

An additional design goal for our game was to keep it flexible: The game could be casually approached by searching only for a part of the artworks during one day and return to the game adventure on a later occasion. In Kultima's definition

(2009) flexibility means that the game supports spatial, temporal and social pervasiveness. We as the designers of Sigrid-Secrets also aimed at an experience that would allow other parallel activities such as strolling in the park and admiring the city with its various structures from this perspective. Furthermore, we aimed at a *leisurely* game experience, which follows one the one hand a non-competitive idea of walking in the park and at the same time seeking for the 'treasures' the hidden photographic artworks entail.

The second dimension and design goal (and an work-in-progress feature) of our game would be an additional layer to the geocaching game – an application that would bring the toy photographs 'alive' by activating supplementary features such as AR-animations on the photographs that would allow the players to play mini-games of e.g. riddles and answering trivia questions. The third, and final dimension of our game would ultimately be an AR feature that would present the player with further content in relation to the Sigrid character. The ideation and design work for Sigrid-Secrets was carried out in fall 2015, well before the launch of PokémonGO (2016), Niantic's immensely pervasive and popular AR-enhanced gaming experience. To us, the game designer's surprise, PokémonGO featured many similarities to what we have planned our game to have. Ultimately, the VR and AR features[3] of Sigrid-Secrets remain in work-in-progress stage until this day. Consequently, the 'artified' game experience builds largely on static images and the narrative delivered to players registered on the Geocaching.com website.

Once the 'Hidden Art' exhibition ended in August 2016, the city authorities gave permission to the authors/game designers to maintain the six artworks and the final cache – a hidden container - in their places. This has allowed us to investigate various aspects of the game in our case studies interested for example in the well-being effects of the trail (Ihamäki & Heljakka, 2017), as well as its possible educational implications (Heljakka & Ihamäki, 2018). To this day, some 272 geocachers report to have visited the trail (as per February 2018).

Figures 1, 2 and 3. Exhibition poster for Sigrid-Secrets as a part of the *Kätketty taide* ('Hidden Art') exhibition and *Vihervuosi* 2016 event; Map depicting locations of the artworks in the parks of Pori; An example of how the artworks are displayed on existing structures such as park benches.

Related Research: Designing LBGs

In 2005, Chen and Michael predicted, that 'games and game technology are poised to transform the way we educate and train students at all levels' (Chen & Michael, 2005, n.p.) One could say that every instance of a played game teaches its players something, but designing for pedagogical outcomes presents game designers with challenges not necessarily associated with the design of casual games. With serious games the primary goal is often that of education.

In order not to design 'chocolate-covered broccoli', as famously stated by Bruckman at the Game Developer's Conference in 1999, designers must recognize factors that predict effectiveness in educational games. According to a review made by Linehan et al. (2011), these factors may be fun, flow, engagement, feedback, goals, problem solving, game balance and pacing, interesting choices and fantasy narrative among many other aspects.

Designing educational games, then, could be seen as a category of serious games, or games with a purpose, which in this case cater for playful learning. Again, Kangas (2010) sees playful learning as a key competence in teaching and learning. Kangas defines the goal of playful learning as follows: It is curriculum-based learning that is enriched with play, games and technological affordances. As

Hirsh-Pasek et al. (2009) describe, both free play and playful learning should command a central role in high-quality education for preschoolers (Hirsh-Pasek et al. 2009, 54).

According to Lihehan et al. (2011) the merging of the disparate goals of education and games design appears problematic. 'Games that teach also need to be games that test', and game designers must work together with educational professionals when aiming to developing serious games as new teaching tools, Chen & Michael remind (2005). When game-based learning is of interest for designers, it is in place to consider how to assess and test in order to determine that the participants can relate to the content of the game, understand the tasks provided and make use of the game appropriately.

Mobile devices enable 21st century students to construct their knowledge any-where and at any time. Mobile learning (or M-learning) is "an educational inter-action delivered through mobile technology and accessed by students from any location" (Traxler, 2009). M-learning is characterized by physical mobility in its flexibility of time, place, pace and space and has used mobile devices with an Internet connection for educational purposes (Kinash et al., 2012). According to Zimmerman and Howard (2013) "mobile devices can situate and connect learners by supporting authentic, context-specific, immediate learning" (Zimmerman and Howard 2013, 2). Consequently, learning is no longer only for the classroom, its integrating mobile technology enables teachers to customize student learning by creating authentic learning activities to engage students, as contemporary pho-neurs (Souza e Silva & Hjorth, 2009) anytime and anywhere (Hess & Gunter, 2013). Several researchers refer to the ability of mobile learning ability to enhance collab-orative learning (Barker et al., 2005; Cheon et al., 2012).

Location-based learning experiences presents a new area of research that poten-tially move and mobilize learning outside of the traditional educational context. Designing location-based games for this purpose (for example, designing geo-caches with educational implications in mind) needs to take several issues into consideration. Benford (2005) discusses the relevance of location-based games to education. His report concludes that location-based experiences could introduce significant benefits for education in schools, but a number of challenges need to be considered and assessed in the process. These include technical challenges

and organizational challenges - questions regarding technological connectivity and matters related for example to privacy concerns and 'culture clashes' in using mobile devices in the educational context. Thus, a factor that presents an increasingly important one that needs assessment, is the one of *functionality of technology*. The second one addresses the *user of the technology*, and the third one the *content provided by this technology*.

Schadenbauer (2008) lists a number of useful questions that are relevant to ask, when conducting research with young people involved as players of a (digital) game, these are both user-oriented, technology-oriented and content-oriented questions, all relevant when considering M-learning (mobile learning): How are mobile phones used by young people? Which media are consumed by teenagers? How often do young people play games? Which kinds of games are popular? How important is social interaction in games? Do teenagers accept mobile learning games? Do the test subjects like the game and the story? Are the tasks difficult/easy? Do the aids help to solve the tasks? Does the framework support the game progress? Which technical problems can occur? Which potential improvement is possible? As well-designed apps presumably provide an appealing platform for learners of the 21st century, it is useful for the designers of location-based games to consider the questions above.

Linehan et al. (2011) claim in their article that studies that try to point to reasons why games can be understood as valuable learning tools often do not include reviewing of empirical evidence. In our study the aim is to tackle this challenge by turning to potential users of our urban game adventure, with a focus on preschool and primary school-aged children. The methodologic approach used for our study will be discussed in the following.

Methodology

Our research investigates how to avoid the pitfalls when designing and using a location-based game like our Sigrid-Secrets geocaching trail in education. The paper at hand focuses on a case study conducted with preschool and primary school-aged children. The question that guided our research was to understand, how preschool and primary-aged school children respond to our urban game adventure during simulated geocaching tours that were guided, narrated and gamified by

ourselves, using our own mobile devices for demonstrating and documenting the tours. In the context of this study, therefore, we asked these questions:

RQ1: What are the potential learning affordances of our urban game-adventure, Sigrid-Secrets?

RQ2: How could the pitfalls in creating opportunities for learning through location-based games be avoided, especially when designing pedagogic aims into an urban gaming experience fit for school-aged children?

We have studied the pervasive game of Geocaching using material from four sources: Our earlier research, on which this study builds, employs 1) user generated data (comments) on the Geocaching.com website. The research reported here uses 2) documentations of play tests, 3) surveys and 4) children's drawings. In addition, our study includes active participation and observation during the play test sessions.

The survey method for assessing the perceptions of our game is adjacent to what (Davis et al., 2005) refer to as *playtests*. In sum, our multimethod approach allows us to target our case study from several perspectives which is needed when the implementations of new types of game design are considered. By organizing three guided tours, we play-tested both the experiential and educational capacity of the trail. This meant that we were interested both in how the game works for the player audience of young children with no previous experience of geocaching. Moreover, what was of interest to us was to test player responses to the second dimension of our game – the animated features including mini-games such as riddles and trivia.

The orchestration of the game adventure included walking the geocaching trail with the children that the game administrators (in our case the authors/researchers) led the players (pre)school children) by reading the story of the main character of the story, Sigrid. Moreover, orchestration involved actively monitoring the children to ensure they stayed out of harm's way and participate actively in the geocaching game (Capra et al. 2005).

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Case Sigrid's Secrets: Studying Simulated Geocaching Tours with School-Aged Children

According to Mäyrä, any gameplay experience is intimately linked with the immediate personal contexts of digital play, which mean that we need to know the players better, how they play, what motivates their play – and/or about their aversion towards certain game forms (Mäyrä, 2007). Again, usability research may help in identifying problems that block users from experiencing the 'fun' of a game (Davis et al., 2005). In games, this means a careful assessment of their playability.

The study presented in this paper centers around the evaluation of our urban game adventure included observation of children in action. Specifically, in the following, we will analyze the player experiences of our location-based game, Sigrid-Secrets. The research reported uses documentations of play tests, surveys and children's drawings. In addition, our study includes active participation and observation during the play test sessions. Surveys tap players' perceptions of games and usability tests may be employed to discover whether the experience the player has of a game matches the designer intended the player to have. A combination of survey and hands-on gameplay together form a method, the playtest, typically interested in the players' initial experience of a game (Davis, Steury & Pagulayan, 2005). In our research the play tests meant a simulated geocaching game of Sigrid-Secrets guided, moderated and documented by the authors. We also experimented with the additional method of asking the children who participated in the playtests to draw images of what they think they learned by playing our game. The results of our multimethod study will be presented in the following.

Guided Tours of the Sigrid-Secrets Geocaching Trail

The guided tours were organized over two days in October 2017. One the first day the authors hosted tours with the two groups consisting of preschool children and their teachers (with n=12 participants in the English group, n=11 participants in the Finnish/English group, and two teachers in each group). Each guided test tour of the trail ranged between 45 minutes to 1 hour in length to complete. At the end of the tour we asked each participant to each fill in a survey and to draw a picture of what they learned and remembered from of the geocaching trail. Two children in the Swedish speaking group (i.e. the third-graders, n=12), were familiar with geocaching either because of having played the game elsewhere with their family

before, or because having toured the Sigrid-Secrets trail prior to our guided tour. Generally, the participating preschool children had not played geocaching before, nor had it been used by the preschool teachers either in informal or formal learning situations. However, many children reported – when asked – to have played Pokémon GO in the Raatihuone Park (the starting point for the Sigrid-Secrets game experience) – a hotspot for caching 'Pokemonsters' since the summer of 2016.

During the tours we as the researchers narrated the experience by using the story of the character of Sigrid based on the text that is available on the game's website under Geocaching.com, and guided the groups by walking from artwork to artwork.

As our 'artified' game experience represents a work-in-progress project, not all of its designed features are available at the moment. Each of the artworks which represent the character of Sigrid in different activities involves a mini-game such as a riddle as presented through e.g. a short animation, which in the future phases of continuing the development of the game will be a part of its digital enhancement and available through an app. Consequently, these features were simulated to the groups by using mobile devices and explaining that they are going to be a part of this game in the future. In order to activate the children in order to play the mini-games with us as the tour guides, we played each animation from a tablet and asked the groups questions such as: "What is Sigrid's second name?" (the letters may be found both on the artwork and the animation); "What do the colors in the animated film remind you of?" or "Which are the colors of the rainbow?"; "Which instrument does Sigrid play in the animation?"; "What is Sigrid doing in the animation?"; "What are they doing in this historical film?"; and "Where is this scenery from?" or "What bird makes the kind of sound you are able to hear in the background?". Some of these questions could be solved by looking at the static image in the artwork only, whereas some needed to be found in the animations (including sound) to be unlocked through the images by a mobile device and app.

Observations

According to our analysis, the educational affordances of Sigrid-Secrets may be grouped in the following categories: a) spatial design affordances, b) narrative design affordances, and c) interactive design affordances. Examples of these will be given in the following.

During the tours it became apparent that the children liked the idea of a 'treasure hunt'. Many of them enjoyed the competitive aspect of the 'game within a game' they developed by themselves during our guided walk, i.e. who will find the artworks first. Although this proves that children are innovative in coming up their own rules for existing games, this possibility is an unintended design affordance. In geocaching, the question is not so much about how fast you find the caches, but rather, how many you find during a longer period of time.[4]

Observation for educational affordance of an LBG: Design features for the game that demand physical skills such as ones relating to speed and dexterity.

During the tour with the English preschool children, some participants asked about the number of artworks placed on the trail (altogether 6) and some were interested in how far they would need to walk during the tour. Both of these represent the games *spatial design affordances* having to do with its lay out. Some of the children jumped on the public artworks found in the park area, but which were not a part of the geocaching trail[5]. The elements outside of the game belong to the city structures, which can be interpreted as intentional affordances of the park, but unintentional design affordances of the game.

Observation for educational affordance of an LBG: Design features for the game that use the city structures for teaching about measurable entities (e.g. geometry, architecture, physics etc.)

Children in both groups paid attention to an unintended *spatial design affordance* in the end of the trail, where they met with a fly agaric (poisonous mushroom). They used a relatively long time to inspect this. Based on our earlier research on geocaching (e.g. Ihamäki & Heljakka, 2017), we have come to understand that adults, too, become more interested in what can be found in the environment outside of the game when they are looking for caches in the name of geocaching.

Observation for educational affordance of an LBG: Design features for the game that teach about the city's flora and fauna (e.g. tasks related to biology).

Some of the children told us that they have been students of a local dance school which is part of the information given in the Sigrid-Secrets story. They also enjoyed a historical short film that show people rowing across the river Kokemäenjoki river and where there presently is a bridge. The possibility to interact with the

story of Sigrid-Secrets based on the previous knowledge and experiences of the local people, is an intentional *narrative design affordance*. One of the children in the group considered the Sigrid character (a doll), as "creepy". This character (a doll) also represents an intentionally designed feature of the game, or *narrative design affordance*, but its potential "creepiness" not, which is an unintentional design feature.

The participants in the study were enthusiastic about the short animations that are going to be made available as a part of the game that has to be unlocked with an app, and the functions of which we now simulated by playing them for the groups from a tablet. The participants were excited e.g. by the mini-game that asked them to find out Sigrid's second name by re-arranging letters that floated around Sigrid in the animation. The children also liked the animation with the dancing Sigrid, which they considered 'magical' (English group). This animation also provoked laughter with the second group (Finnish-speaking group). The children were also enthusiastic about the sounds of a seagull featured in one of the animations from where they needed to recognize the bird. This represents an interactive design affordance that from the viewpoint of the game designers, is intentional and educational as it requires cognitive skills from the players.

Our other observations made during the guided test tours of the Sigrid-Secrets geocaching trail have to do with the challenges and difficulties that we as the guides (and researchers) of the tour experienced during the walks. These include factors outside of the game, but that nevertheless affect the overall experience when a technologically enhanced game is played outdoors. These include the functioning of the Wi-Fi connections, working of the mobile devices (running out of batteries and space, slowness of functioning etc.); the weather conditions during the game-playing; the risks of moving with groups of young children in the city center; and the maintenance of the geocaching trail, which may be affected by e.g. construction work carried out in the area where the trail is located.

Survey

The preschool teacher in the English speaking preschool group informed the researchers that the children had experienced filling in the survey as difficult. Again, the 3rd graders of the Swedish school had, according to their teacher "filled the survey in the best way they could". Because of this, questions on validity arise.

Nevertheless, the surveys, in which we asked the adventureness of the trail, its length, about learning on the trail and a possibility to give free comments, the children described it as "good" and "fun". In the most cases they graded the experience with its features between 3-5 (3=good, 4=better than good, 5= excellent).

Drawings

Children's drawings (for example, see Figure 5.) of what they thought they had learned by touring the geocaching trail addressed several aspects of the trail. They varied from images of the trail itself to descriptions on the park surroundings and to the weather conditions. Roughly, the drawings could be divided into two categories – those of maps of the trail (based on the children's own observations, as maps of the trail were never shown to them) and those of the surroundings of the trail, mostly featuring trees and infrastructure in the park. Many of the children who we interviewed and videotaped when they explained what they had drawn mentioned the 'treasures', i.e. artworks on the trail and the actual geocache, located in a secret stash underneath trees.

Figures 4 and 5. A mushroom at the end of the geocaching trail caught the children's attention; A drawing made of the geocaching trail by a 6-year old girl. She explained the red object to be a park bench underneath which the children discovered an artwork.

Affording Opportunities for Playful Learning through Geocaching

Our assessment of the game adventure begins by comparing the design goals with the results of the play tests. As the results of the first phase of our research

with transgenerational users of the urban geocaching trail illustrate, the user experiences are multidimensional (Ihamäki & Heljakka, 2017). A general overview of the detected affordances shows that it is possible to categorize a set of different design affordances that relate to the game and ones that are part of the environment, in our case park area in an urban center. These are either an intentional or an unintentional part of the geocaching trails game-specific affordances. According to our analysis, the affordances of Sigrid-Secrets may be grouped in the following categories: a) spatial design affordances, b) narrative design affordances, and c) interactive design affordances. The intended, designed affordances of an urban geocaching trail enhanced with artworks are controlled by its designers, whereas unintended design affordances emerge when users explore and interact with the game, depending on the players, the changes in the environment (spatial surroundings) and e.g. the weather conditions. The tests revealed both intended and unintended design features which we here describe as pitfalls. These are pitfalls which can be faced when school children are taken to experience an urban adventure gamescape with educational outcomes in mind. Challenges in designing for urban playscapes with educational intentions in mind include, according to our study a) challenges in interaction in gameplay (real world interaction, interaction with other players, b) challenges in impact of location (situational factors) and c) challenges in responses to game aesthetics and narrative. Based on these, we developed the following design guidelines:

General design guidelines: Suggestions for future designers of urban adventure gamescapes for learning:

- To avoid pitfalls in designing for *interaction in gameplay*: Design the LGB so that its goal, mechanics and approximate length is informed and easily understood by the players before they start to play (together) and that the players know what to expect.
- To avoid pitfalls in designing the *location of the game*: Design the LGB in cooperation with whoever is in charge of the location (e.g. city officials in charge of maintenance of your game's elements in the physical environment) to ensure that the game elements stay intact.
- To avoid pitfalls in designing the *aesthetics and narrative of the game*: Design the LGB to include approachable (in the case of young players,

child-friendly) characters so that the players are not scared off by anything to be considered 'creepy'.

Summing Up the Pitfalls in the Park – Avoiding Unwanted Outcomes of Location-Based Game Design

Two research questions guided our process. These were: 1) What are the potential learning affordances of our urban game-adventure, Sigrid-Secrets? And 2) How could the pitfalls in creating opportunities for learning through location-based games be avoided, especially when designing pedagogic aims into an urban gaming experience fit for school-aged children?

Following important questions ask when designing LGBs according to Benford (2005), the most relevant to our study proved to be: How important is social interaction in games? Do the test subjects like the game and the story? Are the tasks difficult/easy? Do the aids help to solve the tasks? Does the framework support the game progress? Which technical problems can occur? and Which potential improvement is possible?

Assessing perceptions of the game by conducting playtests with young children provided us as the designers and researchers of the game valuable feedback. We suggested possible educational ideas on affordances that stemmed from our observations. Again, a summary of the results of our case study point to that the unwanted outcomes of a designed LBG may relate to user-oriented, technology-oriented and content-oriented matters, which should be considered in design work. In our case issues relating to interaction, location and aesthetics/narrative proved to present the most prominent instances of unwanted design, which could be overcome with improved design.

Findings show that geocaching as a platform has potential to be used for educational purposes of the innovative kind, but playing in the urban, outdoor environment also brings possible challenges with it. In general, when designing location-based games there needs to be awareness to avoid the pitfalls that players of different ages can face in the middle of urban environments. In our case study, these concerned the game itself (content and technology-related challenges), the game presentation (its physical presence and challenges of maintenance in the parks), the players (challenges in uncontrollable movement of young children) and

seasonal constraints (weather conditions). The three first ones of the aforementioned can be avoided by thoughtful design, while the last may be avoided when play sessions are organized only at times with ideal weather conditions. To sum up, we have given some suggestions in the form of design guidelines for future designers of urban adventure gamescapes for learning.

Figure 6. Avoiding the pitfalls when playing urban adventure games with young learners

Conclusion

In this paper we have explored how the cityscape provides both a formal and an informal setting for learning, when a LBG such as our Sigrid-Secrets is used for game-based learning in outdoor play. We found, that the participants of the guided test tours interacted with our Sigrid-Secrets geocaching trail through three affordances, namely the affordances in relation to its spatiality, narrativity and reciprocal interaction between the game and the player. The tentative results point to that children as young as the preschool and primary school children in our study, can by playing the game in teacher-supervised and guided situations, effectively learn about the urban infrastructure and information embedded in the game's narrative – in this case the story of Sigrid-Secrets that links to the city's historical past and present.

By turning to the participants of our case study, we were able to see how the children interacted creatively with the city park environment, how experiencing the game sparked their artistry when drawing images of the trail, how they immersed themselves in the story of Sigrid through their imagined 'treasure hunt' for the

artworks, how they innovated new uses of the parks structures e.g. by climbing and jumping from the park benches and concrete structures and how they used their personal expression in explaining their meaningful memories of the trail and what it, most prominently, taught them.

Finally, by letting the early learners show us how they interacted with our geocaching trail, we were able to see how collaborative learning may take place outside of the classroom when the game of geocaching is played in a social situation. By seeing how the children played, it was able for us to sense their excitement, engagement and discovering of the fun of what playful learning in the park, instead of the usual school surroundings, may mean to them. We propose that acceptability, accessibility, flexibility, simplicity are useful design values to consider when designing location-based games as urban adventures in cityscapes. Further, we add that game interaction, location and aesthetics/narrative should be carefully considered mainly based on their acceptability and accessibility. Finally, we have suggested some guidelines that, according to our understanding, are central to designing similar multidimensional geocaching trails as the urban Sigrid-Secrets game-adventure presented in this paper. Further research questions may include the teacher perspective. For example, What kind of content would educators see relevant to employ in narratives embedded in LBGs like Sigrid-Secrets. And: How would educators like to measure the outcomes of learning if such game-based learning experiences were used in the future?

Neustaedter, Moulder and Wakkary et al. (2012) have noted that what might be challenging in designing 'mixed-reality games' is to ensure the 'scalability' of these games. In other words, it is the possibility to duplicate these games in various locations, or to sustain long-term participation in them. In this research, our larger project interested in location-based game development and related research now also includes the design and execution of another similar location-based game adventure in the city of Rauma – a continuation and further development of the story of Sigrid. Our second urban game adventure based some 50km southwards from Pori in the UNESCO heritage site of Old Rauma on the West Coast of Finland. There, the story of Little Sigrid continues with new adventures and a work-in-progress app in design for players of different ages and gamer profiles even outside of the geocaching community. This second phase of our research will reveal whether or not an urban game-adventure is possible to continue in a second location and

perhaps, allow the interaction between these two geographically separate, but virtually connected gamescapes to enter a playful – entertaining and educational – dialogue, and in this way enrich the overall experience of playing with Sigrid.

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Notes

1. It is important to note, however, that although the game is physically easy to access (the photographs are permanently exhibited in the surroundings of the city parks), the digital component needed for the game – the Geocaching app – is needed at this time to communicate the idea and content of the game. Our plan is, initially, to launch an app specifically designed for Sigrid-Secrets, which would enable users not familiar with the game of geocaching, to be able to play it as well.

2. As the game is physically based in the public sphere in the context of the city park it is also possible that it's accessed by the non-playing audience, or approached by curious individuals, who start to look out and follow the artworks spread in the park. It is still unlikely that a spontaneous instance of game play like this would ultimately lead to finding the actual geocache, as it is well hidden in a secret spot not visible to passers-by as might be the case for the artworks.

3. The future of location-based experiences brings to the fore many interesting research topics, one of them being what Augmented Reality will bring to these game experiences.

4. However, for geocachers familiar with the Geocaching game logic, there is a special goal: when a geocache is launched, whoever finds that first will receive the "First to Find" title, a merit within the geocaching community.

5. In this way, they utilized the playful urban space to a physical activity adjacent to parkour (see e.g. De Souza e Silva & Hjorth, 2009).

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