The internet of art as a site for learning and fun – Playful experiences through augmented geocaching

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Abstract. The Internet of Art as in public and connected art installations gives birth to interactivity and participation, which in turn, introduce new challenges, not only to the production of artworks, but also in how to involve the participants and how to evaluate the results of target experiences, such as social connectedness, context, playfulness, and gamification. This case study presents an example of interactive and participatory forms of the Internet of Art. We have used a multimethod approach including qualitative research methods to understand preschool-aged children's experiences who used the Sigrid-Secrets Augmented Reality application in playing the game of geocaching and finding physical artworks prior to the geocache. We have observed two groups of preschoolers play-testing, analysed the videotaped documentation of the testing, and followed the children drawing their memorable experiences of the geocaching trail. By using the Playful Experiences (PLEX) framework, we have evaluated the preschoolers' memorable experiences of playing. Our findings demonstrate how augmented techniques can be used to transform the physical surroundings in order to create a hybrid game-world suited for learning and fun. In this game-world the player can become immersed in the flow of playful experiences, and engage with edutaining exercises while being simultaneously connected to both to the Internet of Art and to the physical dimensions of the real world environment.

Keywords: Internet of Things, Internet of Art, Gamification, Geocaching, Augmented Reality (AR) Application, Sigrid-Secrets Geocache.

1 Introduction

When considering public spaces like urban parks, one way to engage people in interacting more with their city is through public and augmented art installations. When interacting with this kind of art, the onlookers change their role of participation from spectator to actor by influencing the art piece in their own way by, for example, sharing their own photographs of the art by using augmented reality pictures [1], [2], [3], [4]. In our study, we have aimed to understand how playful, artistic content may be employed in creating meaningful and memorable experiences for preschool children in an augmented geocaching game—the Sigrid-Secrets geocaching trail.

This study explores the Internet of Art through the Sigrid-Secrets geocaching trail by using an augmented reality (AR) application to connect artworks and stories of Sigrid, the main character of the game. In the study, we investigate how preschool children experience this 'artified' geocaching trail when using a mobile AR application. We conducted play-tests to explore various types of player interaction and playful experiences of the game, and examined the influence of connectedness in relation to the Internet of Art. Playful experiences are realized when people take a playful approach to activities or in how they look at the world. A prime example of playful experiences include narrative stories like the Sigrid-Secrets geocaching trail explored in our study. The original PLEX framework identifies 22 categories of playfulness based on previous theoretical work on pleasurable experience [5], game experience [6] [7], emotions [8], elements of play [9], and reasons why people play [10] [11].

This study used the PLEX framework to explore the suitability of the framework to be used as a checklist when assessing different aspects of playfulness related to augmented, outdoor and urban gaming, like in the case for the AR app developed for the Sigrid-Secrets geocaching trail. The structure of this article is the following: Section two after the introduction explains the Internet of Things (IoT) phenomenon and outlines our definition of the Internet of Art as an area of IoT. The third section describes the used method of our study in its three phases, which are: 1) observing the groups' test-playing of Sigrid-Secrets, 2) collecting and documenting the feedback from the test-playing preschool children and their teachers, and 3) analyzing the children's drawings of their most memorable experiences related to the playing of Sigrid-Secrets. The fourth section presents the results of the participants' experiences of the Internet of Art. The fifth section presents a discussion on the Sigrid-Secrets AR application through the preschoolers' experiences. Finally, the sixth section presents the conclusions of the study and presents ideas on future work.

2 The Internet of Art

The current development in public art installations involves a new combination of material and technology, resulting in new dynamic, interactive or participatory forms that require the artist and designers to construct their work form a system view and with a good understanding of human—system interaction [2], [4]. The context of public spaces in cities present possibilities on how the participants as viewers of artworks and players of games may leave a mark of their interaction with both of these. The "Leave your mark" possibility could in our case be placed as an 'invitation to play' for people to allow them to freely express themselves by, for example sharing Sigrid-Secrets AR photographs on social media channels. This approach will potentially help people feel more connected with the art and more included in the 'artified' space they are in [12]. There has been much debate concerning the definition of art related to the Internet since the 1990s. However, there is not one specific terminology for the 'Art Internet', or how we refer to it here as the Internet of Art. This debate is rooted in the fragmented nature of the practice reflecting ideas, styles and methods of practitioners [13]. The concept of "Net-based art forms" was proposed by Daniels & Reisinger in 2009 [14, pp. 15] when referring to artworks produced between 1992 and 1997, the earliest

period of production of the Internet Art [14]. Major traits of the Internet Art are related to shared affordances of the Internet, like participation as a 'social mechanism' [15, pp. 485] granting interactivity between recipient and artwork, and connectivity, as multiple community forms and dynamism in usage of content of various nature may be created. Lovejoy, Paul and Vesna (2011) see that digital technology as an artistic medium implies that productions result in a work of digital format reflecting the intrinsic customizable, interactive and dynamic possibilities of the Internet medium [16]. There is also a contrast to digital technology as a tool, as this tool is used to assist production of traditional art objects and to convert tangible artworks into digital formats.

Shulgin et al (2001) have produced a manifesto positioning 'net.art' as an avant-garde practice with close ties to the Internet as a communication channel. They have listed Internet art traits as the following: 1) Formation of communities of artists across nations and disciplines, 2) Investment without material interest, 3) Collaboration without consideration of appropriation of ideas, 4) Privileging communication over representation, 5) Immediacy, 6) Immateriality, 7) Temporality, 8) Process-based action, 9) Play and performance without concern of fear of historical consequences, 10) Parasitism as Strategy; a) Movement from initial feeding ground of the Internet, b) Expansion into real life networked infrastructures, 11) Vanishing boundaries between private and public, and 12) All in one: a) the Internet as a medium for production, publication, distribution, promotion, dialogue, consumption and critique, b) Disintegration and mutation of the artist, curator, pen-pal, audience, gallery, theorist, art collector, and museums. [17]

In this case study we define the *Internet of Art* to have four dimensions: The Internet of Art may include 1) Physical artworks, which extend to the digital art space (digital versions of art works, which reside on the Internet); 2) Physical artworks, which include a digital dimension, and which are connected other artworks, 3) Physical artworks, which include digital interactive art works (involving the user to interact with the art- work and with other users), and 4) Digital artworks, which are connected to other art- works through the Internet and belong to the ecosystem of the Internet of Art.

Using this comprehensive definition of the concept, we contextualize our understanding of the Internet of Art within the public sphere of the park and the use of the digitally- enhanced, but physically based geocaching gaming platform. Further, we suggest that when the functionality and usability as dimensions of the game's playability have been accommodated in the geocaching trail, it is time to add positive aspects of interaction such as fun, surprising and playful content into the experience, which is nowadays a common design goal for many services and products.

3 Method

We have used a qualitative approach in our study. We have collected data with a multimethod approach, which is based on preschool children's group testing of the Sigrid-Secrets geocaching trail by using a mobile AR application called Sigrid-Secrets. We worked with n=20 preschoolers; 5-6-year old boys and girls from two preschool groups and four teachers from a Finnish kindergarten. We met with the children in their classroom and explained the content of the geocaching trail, where we will go during the test-playing in the park, and what we are going to do with the mobile device (iPad). Throughout the test-playing session, we documented via notes, video and photographs so that we could later review children's experiences. After walking the geocaching trail,

which is about 1 kilometer in length, we came back to the kindergarten and asked the children to draw their chosen memorable experiences of the geocaching trail and asked them questions like "what is your most memorable experience of the Sigrid-Secrets geocaching trail", "what happened when you saw the mobile device 'bring the artwork alive'", "what was the funniest experience on the Sigrid-Secrets geocaching trail", "what did you learn from the Sigrid-Secrets geocaching trail", and "how would you play the Sigrid-Secrets geocaching trail with your friends?".

The use of drawings for evaluation purposes is a powerful tool, since most children tend to enjoy drawing without showing any sign of tension. Crook (1985) presents that drawing is widely recognized by children as an activity and that the content of children's drawing may provide insight into their feelings and thoughts about the world. In other words, children's drawings provide a 'window' into their thoughts and feelings, mainly because they reflect an image of his or her own mind. When children draw, they carefully choose their materials, crayons, colors, patterns, plus the size and position of what they want to draw [24]. Children's drawings are unique and can give us precise information about their feelings and though about subject what researchers are investigate [25]. While drawings represent a kind of individual expression, they can also be a communicative tool. Drawing tends to recount far more things to the reader than language. Children do not yet have sufficient capabilities for abstract linguistic expression, but they have symbolic communication methods such as drawing. Through pictures, children communicate with familiar people, they develop skills for living and build a sense of trust [26].

We have used the drawings as a method to understand children's most memorable experiences of the Sigrid-Secrets geocaching trail when using an augmented reality application throughout the test-playing. Moreover, we have compared the children's testimonials of their most memorable experiences with their drawings of the Sigrid-Secrets geocaching trail, which gives a holistic overview of experiences especially in terms of how the children explained their experiences of the AR application. The multimethod approach allowed us to carry out both a narrative and visual analysis of data. Afterwards, we have analyzed all material by using content analysis.

We have categorized our method in three phases, which are 1) observing the group play-testing, 2) collecting and documenting the feedback from the preschoolers and their teachers, and 3) understanding children's drawings and play experiences.

Phase 1: Observing the group-tests

In order to gain a good understanding of the benefits and drawbacks of computational elements (the digitally-mediated augmentation) of the geocaching trail, we emphasized observation prior to implementing a first version of an augmented reality application called Sigrid-Secrets. Our group-tests were carried out at the Sigrid-Secrets geocaching trail, which was created in 2016 and includes six physical artworks that can be found by using the geocaching application or the Sigrid-Secrets AR application presented in this paper. The story behind the game gives hints on where the six physical art works and the geocache can be found. By using the Sigrid-Secrets AR application the players of the game can experience the physical artworks with their virtually augmented dimensions. Our group test focused on children's experiences of and interaction with the Sigrid-Secrets application, their experiences of looking for the artworks, and their drawings and testimonials about the Sigrid-Secrets geocaching trail more generally. One of the goals in our study is to understand the urban outdoor space as a learning

environment, for example, what preschool children can learn from the historical narrative accompanying the game, the collaborative working (in searching for the artworks together), and how the participating children understand the multiliteracy required from playing with hybrid game-worlds combining physical and digital art/game environments.

Phase 2: Collecting and documenting feedback from preschoolers and their teachers
After the test-playing, participating children were invited to fill the Playful Experience (PLEX) evaluation form with preschool teachers and draw their memorable experiences of the Sigrid-Secrets geocaching trail. We asked the children to evaluate their experiences of the geocaching trail, for example, by asking: "how did you like the geocaching trail?", "what was the funniest things to do on the geocaching trail?", "was it easy to find the artworks?", "do you remember some artwork especially well, how did you feel about those artworks?", "how did you think about looking at the artworks through the iPad?", "what was really happening on the iPad when you looked at the physical artworks?", and "would you want to do something with the Sigrid-Secrets mobile app together with a friend?".

We also collected data with the help of the preschool teachers, who participated in walking the geocaching trail. The teachers were asked to fill the PLEX evaluation form. The PLEX model we built on, suggests a framework to understand the playful dimensions related to the experiences throughout the Sigrid-Secrets geocaching trail. Our PLEX evaluation of the Sigrid-Secrets geocaching trail included validation efforts such as playing the treasure hunt game geocaching together with the Sigrid-Secrets AR mobile application, to see what experiences this app prompted in use (in this case in pre- school-aged children). As a result, 15 categories of the original PLEX framework (including 22 categories) were included in the Playful Experience of the Sigrid Secrets geocaching trail through the augmented Sigrid-Secrets app (see Tables 1 and 2).

Phase 3: Understanding children's drawings and play experiences
After the test-playing we asked the children to draw their memorable experience of the geocaching trail. We asked what they were drawing and what they did in the specific part of the geocaching trail they depicted in their drawing. We videotaped the children while they were making their drawings and explaining them, which we analyzed together with other research material. We have used an in-game evaluation technique we refer here to as 'think-aloud'. By doing so, we may have captured a more immediate and visceral response to the playful experiences, as there were some limitation to how we as the researchers guiding the test-playing could also follow the children's responses to the game. After finding each of the six physical artworks connected to the narrative of Sigrid-Secrets, we demonstrated the augmented reality materials accessible through a mobile device featuring the app needed to unleash the digital components of the artworks (iPad).

4 Results: Internet of Art related, augmented play experiences

Evaluation of PLEX of the Internet of Art

In this study, we have explored play experiences of the augmented Sigrid-Secrets geocaching trail from the perspective of preschool children and their teachers, which we analyzed through the PLEX Framework. We have tried to understand the existing geocaching game as an urban 'artified' experience related to the Internet of Art and investigated what the children and teachers considered valuable about the geocaching trail (space) through the augmented reality mobile application (treasure hunt activities used in searching for physical artworks and using a mobile device to access the digitally augmented dimension of the artworks).

Evaluation of the test-playing conducted for the study reveals that overall, participants were fully engaged in the geocaching game we described as the "Sigrid-Secrets Adventure". In general, the findings support the 15 experiences included in the PLEX framework. These were analyzed in association with the Internet of Art experience that the Sigrid-Secrets geocaching trail represents, and are described in more detail in the Tables 1 and 2. The recent development in hybrid technologies create new opportunities for artists and researchers to create and study interactive public installations we understand here as the Internet of Art, merging physical material with digital content (for example, Augmented Reality (or AR) technologies), allowing social engagement and participation. This study has employed Augmented Reality techniques, which were used to transform and augment the users' (in this case preschool children's) visual and auditory perceptions of the location (special physical location of artworks). Augmented reality animations were shown to the play-testers with the help of mobile devices with the aim of creating the illusion that the Sigrid-Secrets physical artworks are actually merging with a mixed reality environment in the player's surrounding. The augmented reality effect was perceived as quite realistic as the preschoolers informed us that artworks are exciting, and even made some of the children feel tension. However, besides the excitement of the augmented dimensions of the game, our findings show that by far the most engaging aspects of gameplay were connected to the geocaching game's original mechanics the treasure hunt game. For the most part, participants found the treasure-hunting mechanic satisfying and enjoyed the process of physically moving around the environment searching for the Internet of Art locations for the physical artworks. The discoveries made in the physical environment and finding the artworks represented playful experiences in themselves. However, an additional element of surprise created by using the mobile application and bringing the Sigrid-Secrets artworks alive was considered as an interesting, intriguing, and in this way valuable dimension of the experience.

The preschoolers as play-testers used the multimodal features of the Sigrid-Secrets geocaching trail Sigrid-Secrets App interface as a guide when searching for the physical artworks. Simultaneously, they had multisensory experiences: both visual and audio-based augmented reality experiences. For example, in the first artwork, the augmented dimension shows an animation of some letters of the alphabet appearing on the screen of the mobile device one by one, and from those letters the players are able to form the second name of Sigrid, the character in the game. These tasks presented by the artworks make children 'speak aloud'

collectively by saying those letters. In this particular riddle or mini-game, the participating preschoolers solved the challenge together and received a pleasurable experience connecting them further with the Sigrid-Secrets adventure. Moreover, the results also show how the location contributed to the overall game experience because the historical story (Sigrid-Secrets narrative including facts of the city) fit the context and geocaching trail. In general, the findings support the PLEX model that indicates playful experiences with the 15 categories of the Internet of Art related Sigrid-Secrets geocaching trail as presented in the Tables 1 and 2.

Table 1. Evaluation through the Playful Experience (PLEX) of the Internet of Art: Sigrid-Secrets geocaching trail, examples of preschool-teachers' perspectives.

Playful Experience	Sigrid-Secrets geocaching trail test-round (preschool teachers' perspectives, examples of answers given)
Challenge	Teacher 1: The weather was bad and some of the children experienced the cold because of wet clothing. [What proposed additional challenges was] the noise coming from traffic and roadworks, the dog excrement in the park. Teacher 4: [What proposed challenges] was the weather, and the noise coming from traffic that makes it hard to hear the story. The size of the group should be considered.
Competition	Teacher 1: Competitiveness arose from when the children tried to be the 'first to find'. Competition also comes from who is the one to see 'best and first'.
Completion	Teacher 4: To draw is a good way of returning to the trail [after the round] and to reflect upon what was nice [about the experience].
Control	Teacher 1: The children followed well and controlling of the situation functioned when there were enough adults [supervising the situation] so that the screen of the mobile device [playing the animations for the experience] could be followed.
Discovery	Teacher 1: The group size of approximately 10 children would be good. The joy of discovery at every image, and especially at the geocache [was perceivable].
Exploration	Teacher 1: To solve the riddles was really motivating and the whole group was involved in a good way, the observation of the environment, exploration and telling about ones' own experiences [also worked well]. Teacher 3: The exploration [of the trail] was also inspiring, and the story was not terribly hard to preschoolers' to understand, either. Teacher 4: [It was] interesting to see how the image came to life!
Expression	Teacher 1: To know the letters [of the alphabet], and to explore and know things is important. Children need [or, they have a need] to tell what they can do and what they know.
Fantasy	Teacher 1: The enlivening of the image made the children continue the story in one way or another, or linking it to their earlier experiences. Teacher 3: The images enlivened the imagination in a great way.
Fellowship	Teacher 1: To look [for the artworks] together—to find, and to share the joy of finding with others, having to wait for one's own turn. Bringing up what it means to be a [name of city]-citizen [was considered important]. Teacher 2: [Fellowship] between children was quite fluent even though there also was 'me and myself' kind of thinking. Teacher 3: To think about and reflect on the answers [to the questions presented in association with the artworks] created a shared experience. There could have been even more questions on the trail.
Humor	Teacher 1: The images themselves did not exactly add on to the humour, but where there are children, humour is always present in things and doings.
Nurture	Teacher 1: The doll [depicting the character Sigrid] can perhaps evoke the nurturing instinct in some, and maybe fear in some. [To nurture during the test-playing could also mean] looking after ones pair when walking.
Relaxation	Teacher 4: To move about outdoors is always a good thing and the children could later walk [the trail] with their own parents.
Sensation	Teacher 1: [The element of sensation] was present in the videos. [And in the] the sounds and happenings of the environment. Teacher 4: [The element of sensation was] holistically present, sight and hearing.
Sympathy	Teacher 1: The children were prompted to tell about their own knowledge of the phenomena [depicted in the artworks including their augmented dimensions.]
Thrill	Teacher 1: Some of the children thought that the [Sigrid] doll looked 'scary', and some thought the same about the music in the video. When the image came alive on the screen of the mobile device the children empathized well. After the test-playing round Sigrid will live on in the minds [of the children] whenever they return to the [name of the park].

Table 2. Evaluation through the Playful Experience (PLEX) of the Internet of Art: Sigrid-Secrets geocaching trail, examples of researchers' perspectives.

Playful Experience	Sigrid-Secrets geocaching trail test-round (researchers' perspectives)
Challenge	All of the artworks on the geocaching trail include some kind of challenge for the participants to solve—a question or a riddle. For example, the first task was to answer the question: "What is Sigrid's second name?" In Finland, the learning of how to read usually starts in primary school—this task asked for the participants to know the alphabet and think logically. The artwork depicting Sigrid with water colors was, on the one hand, considered to be interesting for some of the participating children. The challenge to solve in association with this artwork was to answer the question: "In which natural phenomenon can the colours that appeared in the video be seen?" One of the children solved this challenge by giving the correct answer: "The rainbow".
Competition	Sigrid-Secrets is a game, in which the main goal is to find all the six artworks and finally, the actual geocache at the end of the trail. The participating children took part in "first to find" competitive form of playing, which they invented themselves when being asked to find an artwork. Seeking for the artworks brought the competitive element of the experience in the foreground, and even seemed to cause some bickering.
Completion	In association with the animation accompanying the first artwork the children started to list the letters that appeared on the screen. We posed the following question: Which name can you form of these letters? The correct answer is the same as Sigrid's second name. First, one of the children came up with the name 'Irma' (not correct). This guess was soon followed by the right answer 'Maria'. The participants seemed to enjoy solving the tasks as they adventured on the geocaching trail. They greatly enjoyed the moment they came up with the right answer.
Control	The children controlled each other: We could sense some "group pressure" as the children competed about who will first find an artwork. The teachers controlled the overall experience of the test-playing round.
Discovery	It was important for the children to discover the artworks. Additionally, the Sigrid-Secrets app launched AR animations for each of the artworks, which the participating children admired. All of the children wanted to see the animations properly in order to think about the content, for example, what colors they saw in the animation. The children also found it enjoyable to discover the actual geocache stashed in an unobvious location.
Exploration	The participating children explored the actual geocache, a 'birdhouse', hidden under a tree. To find the cache seemed to give the children the most gratification in exploring something. In one of the videos there is an old church boat that is being rowed over the [name of river]. This historical video in the early 1900s shows how there was no bridge at this time. One of the children could name the bridge ('Charlotta') that was built later in this place. Simultaneously, the other children learned about the history of their home town.
Expression	The children draw the most memorable experience of the geocaching trail after the test-playing round. Most of the children draw the geocache found at the end of trail – the 'birdhouse'. Some of the children draw Sigrid doing a split, Sigrid playing the music box, and Sigrid adventuring with the children.
Fantasy	The trail presented itself to the children as a fantasy in which they participated, immersed themselves in and followed the story by solving the tasks.
Fellowship	The children looked for the artworks together as a group and one of the children said that they were 'playing the game together'. Playing collectively seems to come naturally.
Humor	The children seemed to like the last of the six artworks best. It features a soundtrack playing the sound of a seagull. They thought that the sound was a fun feature as they recognized the bird making this sound. The children knew these birds to exist in the place depicted on the artwork, [name of beach]. In general, all the artworks which are given colors by the AR app and feature either animations, videos or sound. The videos were considered mysterious and therefore interesting for them.
Nurture	While stopping at the final artwork, the participating children met with a lady walking her dog. The children petted the dog. We see this as an example of how the children quickly reacted to the environment and engaged with it. In this way, the children enjoyed external stimuli outside of the actual game and afforded by situational factors.
Relaxation	Becoming excited about the adventure that the 'artified' geocaching trail aims to offer, and the joy of discovering the artworks made the children happy. When they found an artwork, for example, they wanted to explore it as closely as possible. On the way to the last artwork, the children were already running towards it. One of the children accidentally stepped on dog excrement. As the child was the first to find the artwork, the situation was quickly resolved, and instead of disappointment, the child became relaxed.
Sensation	The cold, slushy and rainy weather on the day of test-playing somehow affected the overall experience of the round: Some of the children said that they were feeling cold. The children were anxious about finding the artworks and after finding them, awaited for what kind of surprises the AR app brings to the experience. The AR enhancements for the artworks appealed to the children. According to the teachers, one of the children had told her mother right after the geocaching adventure that s/he would like to take her on the trail and to show her the 'coming alive' of the artworks on his/her phone.
Sympathy	A part of the participating children ranked the animation of the dancing Sigrid as the most memorable. It was also said to be beautiful, and children waited for Sigrid to make the split at the end of the animation, when seeing it another time. According to the teachers none of the children have classic ballet as a hobby in the local dance school.
Thrill	On the one hand, the children found the animation with the music box the most exciting of the six AR augmentations, as they recognized the sound of the instrument. On the other hand, the Sigrid doll playing a music box was also reported to appear 'creepy', according to their documented testimonials. Three of the artworks raised most comments among the children, when they were interviewed during them drawing their most memorable experiences of the test-playing trail: 1) The artwork with the music box. The sound of the music box seemed familiar to the children, but playing the music box seemed unfamiliar; 2) The artwork with the dancing Sigrid was experienced as exciting because the doll was seen dancing, and during the second time watching the animation the children already knew that it would end with Sigrid doing a split; 3) The last artwork was considered as the most fun of the six artworks. In this artwork Sigrid is depicted holding a photograph of [name of beach] in her hands.

Figure 1. Test-playing the Sigrid-Secrets geocaching trail.

Evaluation of preschool children's drawings of their play experiences

The preschool children drawings function as an additional research data set and focuses on Sigrid-Secrets geocaching trail memorable experiences. The drawing below (Figure 2.) shows how children were inspired by the Sigrid-Secrets AR application.

Figure 2. Preschooler "Toini" drew Sigrid making a ballet split. **Figure 3.** Sigrid-Secrets AR application artwork, which is brought alive and dancing by the AR app.

The Figure 2. was, according to the preschooler, who we observed and interviewed, inspired by the Sigrid-Secrets ballet dancing animation and showed a detailed view of the video, demonstrated similar color and line and use of chair of the video (see Figure 3.). This could be due to the Sigrid-Secrets application augmented reality experience. Preschool children reported to mostly like the end of geocaching trail, where they could find the actual geocache. The drawing by "Joose" in Figure 4. reflected the geographic location of the Sigrid-Secrets geocache place, which according to our analysis, seemed to be most exciting place of the Sigrid-Secrets geocaching trail. The drawings also included the Sigrid-Secrets music-box artwork (for example, see Figure 5.), which represent to the preschool children a memorable experience in association with Sigrid-Secrets augmented reality application. The drawing also shows the collective nature of experiences with preschool friends who joined the play-testing of the geocaching trail.

Figure 4. The Sigrid-Secrets geocache at the end of the trail. **Figure 5.** Children "Joose" drew the Sigrid to music box artwork and the final geocache in the same picture.

5 Conclusion and Future Research

Our results show that existing Augmented Reality techniques can be used to transform the surrounding in order to create a hybrid game-world where the players, as in this case study preschool children, can become immersed in the flow of play while simultaneously remaining connected both to the Internet of Art and to the real world.

In this paper, we have used the Playful Experience (PLEX) framework to explore its potential for evaluation of preschool children's memorable playful experiences through the Sigrid-Secrets geocaching trail explored together with the AR application. We con- ducted three phases collecting research data: 1) *Phase 1: Observing the group-tests,* 2) *Phase 2: Collecting and documenting the feedback from the preschoolers and their teachers,* 3) *Phase 3: Understanding children's drawings and play experiences*, and evaluated the memorable play experiences of the Sigrid-Secrets geocaching trail.

Our results suggest that the PLEX framework is suitable for evaluation on aspects of play- fulness of the Internet of Art platform. Based on our findings, 15 PLEX categories be- came perceivable in play in the following way: the real physical environment (weather, traffic on the public place so on) may present challenges. *Challenge* also means that we tested the abilities in tasks for example by asking the children to solve six tasks presented in connection with the artworks on the geocaching trail. We found out that a successful group-test with preschool children greatly depends on the size of the test- playing group. The Sigrid-Secrets geocaching trail is based on *competition* to "find the artworks first" Competition means contest with oneself or in testing group participation and this play pattern emerged in our play-testing as well. *Completion* means to finish a major task, and experience a closure for that task. Our results show that children experienced completion when drawing their memorable experiences of the Sigrid-Secrets geocaching trail. *Control* means to dominate and police for the roles in the game-world. In this case study control presented itself as 'group pressure' in preschoolers' behavior in finding the artworks together. *Discovery* means finding something new or unknown. The Sigrid-Secrets geocaching trail offers its players a treasure hunting game adventure with digital dimensions augmented by a mobile application that connects the physical artworks with the Internet of Art. *Exploration* means investigating a situation or object. As in this case study, exploration was presented through a treasure hunt for the physical

artworks, and solving problems together with the group as a co-playing experience. *Expression* means self-creativity and sharing one's own ideas with others. In this case study expression occurred when the children drew their memorable experiences, followed by a group discussing steered by an interest in the preschooler's feedback on playful experiences featured in the PLEX framework. *Fantasy* means an imaginative experience. This case study presents that the Sigrid-Secrets narrative turned walking the geocaching trail into a fantasy game experience. *Fellowship* means friendship and communality. In this case study the preschool children had a collective experience by solving problems together. *Humor* means fun, joy and jokes. In this case study humor came up when the children saw the first Augmented Reality application animation and started to create their own stories based on the artworks. *Nurture* explored in a playful context means to take care of others or toys etc. In this case study, the game-world is situated within the real, physical environment, and as can happen in the real world, there were surprises: For example, suddenly a dog came up and children expressed an urge to nurture it (or, to pet the dog). *Relaxation* means relief for bodily or mental work. In this case study, one of the children accidentally stepped on dog excrement. As the child was the first to find the artwork, the situation was quickly resolved, and instead of disappointment, the child became relaxed. *Sensation* means excitement by simulating senses. In this case study, the preschool children were anxious about finding the artworks and after finding them, awaited for what kind of surprises the AR app brings to the experience. Every time they awaited for the AR-related content and were met with surprise. *Sympathy* means sharing emotional feelings. In this case study, the children started to share their experiences with each other by 'thinking aloud', but also continued their exciting experience by creating their own stories based on the multidimensional Sigrid-Secrets 'artified' and augmented geocaching. *Thrill* means excitement derived from risk. This case study shows that some of children felt that the artworks featuring the Sigrid doll were somehow frightening especially when they came alive through the augmented reality app, which uses sounds and animation, and can be experienced with many senses with the help of this mixed reality environment [21].

Our aim is to continue exploring the Internet of Art in connection with location-based gameworlds by setting up a third augmented geocaching trail in the coastal area adjacent to the first urban trail. In this project we will use the "flipped classroom approach" and work with school-aged children to co-create 'edutaining content' (content that is both entertaining and educational) for the new geocaching trail to support physical, cognitive and social wellbeing of the potential users of the augmented geocaching trail. We are also developing the Sigrid-Secrets app by adding educational exercises suited for pre- school children and first and second graders. In this way, our research continues to explore outdoor, location-based, and augmented game learning experiences, and the question of how to motivate children to fun learning by building on skills and knowledge in their everyday surroundings.

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