

Designing locative human-forest interactions through playful design workshops

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Abstract

Technological advances offer opportunities to motivate and support meaningful interactions with forests and nature. This paper outlines the findings of three distinct design days, all centred on human-forest interaction. The objective is to explore the gameful potential of the intersection between humans, forests, and technology. The design approach in all scenarios involved an outdoor activity, such as geocaching, and a design workshop where card-based ideation methods were used to develop initial ideas. These concepts were further refined and captured as toy-play and play-acting videos. The design days resulted in twelve ideas from twelve groups, each drawing inspiration from the outdoor activity portion of each day which was conducted in a forest or forest-like location. This paper presents the final ideas and analyses them based on their story, characters, setting, values, and goals. The final video outcomes generated by the groups highlight the scope of the design space in human-forest interplay, revealing numerous new avenues for utilising technology in enhancing our connection with forests and nature.

Keywords

Forest, nature, gamification, playful workshop, play, location-based design

1. Introduction

Forests are among the most valuable and complex ecosystems on Earth. They provide numerous beneficial services to humanity such as clean air and water, carbon sequestration, and habitat for biodiversity conservation [1]. However, the relationship between humans and forests is often characterized by conflicts relating to unsustainable practices that can lead to deforestation, degradation, and loss of ecosystem services [2]. Furthermore, coupled with trends such as urbanization, the average person in contemporary society is becoming increasingly disconnected from nature and forests [3]. Thus, conservationists [4] as well as health professionals [5] among others have been interested in creating solutions and approaches to revitalize people's relationships with forests and nature.

In recent years, there has been a growing interest in designing technologies that facilitate positive interactions between humans and forests, promoting

their conservation and sustainable use, and simultaneously providing health benefits for forest visitors [6, 7]. While previous research has utilised workshops to explore nature-inspired design (NID) and biological-inspired design (BID), [8, 9], as well as the use of biomimicry, natural capitalism and cradle-to-cradle strategies in the development of products and services [10, 11], there is a notable gap in the investigation methods and tools that facilitate bio-inspiration for positive human-forest interactions, like games and nature-based experiences, within in these contexts. Designing human-forest interactions may be crucial for achieving environmental and social goals, and design innovation that uses play and gamification should play a key role in motivating and enhancing these interactions.

For these reasons, in this study, three design workshops were conducted with researchers from the fields of gamification and forestry to produce novel ideas for the future of human-forest interplay. The

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research approach has similarities to how jam events (e.g., game jams) are discussed and reported [6, 12] and includes aspects of ideation technique comparison and evaluation [13, 14]. The capturing of ideas as toy-play videos was incorporated, in the spirit of [15], both for encapsulating the ideas in an easily viewable format and as a tool for analysis. Locative applications and games were focussed on specifically, since these hold the potential to both: (1) motivate people to go to forests; and (2) direct how they spend their time there [16, 17]. This results in an innovative research setup in terms of theme and structure, where the ideas are distilled into videos that can be analysed.

The rest of this paper is structured as follows: first, the workshop method is presented, which was a combination of an idea-generation outdoor activity followed by a hands-on indoors design workshop. Second, the design ideas from the three workshops are showcased (12 groups altogether). Third, the videos that were created to encapsulate the ideas are analysed based on their story, characters, settings, values, and goals. Lastly, the next steps in designing and implementing forest-human technologies and thoughts for future research are discussed.

2. Methods

For exploration, building on previous experience [18], three design events were organised where activities were structured in two parts:

1. **An outdoor exploration event** in a Finnish forest, involving nature exploration and exercise through geocaching, discussions on design ideas, learning about nature, and networking.
2. **A playful design workshop** that presented various design approaches for generating novel, technology-mediated interaction design ideas within the forest context.

The first two workshops concentrated on two distinct card-based methods, while the third adopted a more free-form approach that involved the addition of a third set of cards.

The first two outdoor exploration events involved engaging with the location-based game known as geocaching. Geocaching¹ is a location-based treasure-hunt game where players look for hidden containers (caches) with the help of GPS. Launched in 2000, it has more than 3 million active *caches* hidden all over the world. Geocaching has been utilised in previous studies exploring cultural ecosystem services [19], recreational ecosystem services [20] and, as it is a community-generated game, it has been seen as a useful tool for the generation of new game ideas [21].

The ideation methods used are aligned with playful design [22] and influenced by the design methods described in the “*Universal methods of design*” [23]. The process of reporting is inspired by the best practices of how *game jam research* presents the events organised and the resulting games (e.g. [24] and [12]).

Both activities include playful and gamified elements. Specifically, the card-based ideation

methods provided a game-like structure to the ideation process, while the planned outdoor activities also included gameplay. While geocaching provided a playful context for human-forest design ideation, rather than constituting a strictly gamified approach in itself, the use of structured, card-based ideation methods aligns more closely with gamification, as it incorporates game design elements into the ideation process [25].

2.1. Outdoor exploration events

Three outdoor exploration events were organised as part of the three workshops. The first involved a visit to a publicly owned outdoor recreation forest in Tampere, south-central Finland. There, the participants (a mix of gamification and forestry researchers, N=11) were able to meet, network, and share knowledge and experiences about forests and nature. Participants had the opportunity to freely ask questions about Finnish forestry from the experts in the group. They were also introduced to Geocaching. During the field trip, participants created their own geocaching accounts and collaboratively located several caches hidden in the forest. This playful activity was instrumental in familiarising them with the game, experiencing the game flow in the forest, and starting discussions about forest-based game design.

The second event included a field trip (see Figure 1) that involved a visit to a recreation forest of mixed ownership outside Joensuu in eastern Finland. In this field trip, the participants were forestry researchers (N=20) who were taking part in a networking day that involved following a geocaching trail laid out as part of the UNITE flagship². The geocaches along this trail incorporated surveys with questions relating to human-forest relationships and landscape preferences. Consequently, these topics were prevalent in participants’ discussions during the day.



Figure 1: Second field trip.

The third event involved exploring the surroundings of a hut in Finnish Lapland. The participants were attendees at a gamification-focused conference (N=16). At the beginning of the workshop, they were invited to venture into the snow-covered forests surrounding the hut and engage with the environment for an hour in any way they found interesting. They were asked to reflexively focus on their lived experiences during this time and consider if

1 <https://www.geocaching.com/play> (Retrieved 11.1.2024)

2 <https://uniteflagship.fi> (Retrieved 11.1.2024)

and how these experiences brought them joy. After co-experiencing this forest immersion, participants returned to the hut and received a set of small cards to document the things they had just experienced. These cards facilitated the documenting of four types of data:

1. Anecdotes of their experiences.
2. Reflections they had during those events.
3. Design ideas for technologies that could enhance those kinds of experiences.
4. Memories of past forest-related experiences evoked during the exercise.

These cards later served as inspirational material for generating the design ideas elaborated upon during the workshop.

2.2. Workshops

The second part of each design event centred around a design workshop inspired by *game jams* [26], a framework in which several organisers and participants had extensive expertise, both practical and academic. The participants were instructed to build on the experiences and recollections of the field trip and use card-based methods to ideate technologically mediated playful interactions with forests. In all workshops, but especially the first two, the Hybridex Deck [27] and the VNA cards [28] were utilised (see Figure 2). Both methods required participants to draw a sequence of cards from a specific deck, whose combination would offer instructions and inspiration on how to develop a design idea.



Figure 2: Card-based ideation methods VNA (top), Hybridex Deck (middle) and Play potential cards (bottom).

The Hybridex Deck allows for the creation of new ideas or the improvement of an existing one. The users draw a CASE, CATALYST and PATTERN card (and an additional IDEA card if they want to create a new one). CASE cards represent existing examples of hybrid products or services (e.g. Romo the Robot), CATALYST cards present specific phenomena in the area of physical digital hybrids (e.g. quantified self), PATTERN cards highlight patterns of existing cases (e.g. photo play), and, finally, IDEA cards are intended to offer inspiration [27].

The VNA deck is a set of VERB, NOUN, and ADJECTIVE cards, each with just a single word printed on one side. The words, which are related to playful hybrid products and services that combine physical and digital properties, are used to build the idea sequentially, e.g. by taking turns. The VNA method has been used in the past at game jam events [29].

In the third and final workshop, two additional design materials were employed: First, as noted above, participants built on the cards they produced as a result of their 1-hour engagement with the nearby forest. Second, they were given decks of the "human-forest interaction play potentials cards": a collection of cards developed that featured a range of playful experiences identified in recent research into the playful potential of forest-related activities [30]. Taking these two resources as inspirational material, participants were invited to ideate on how technology might support joyful forms of human-nature interaction.

Finally, to concretise and visualise the ideas, toys such as LEGO bricks and other props were used in an activity of low-fi prototyping and pretend playtesting. Participants used play representations of the technologically mediated interaction they ideated and used the props such as LEGO figures to illustrate how users might interact with them. The resulting ideas were finalised and recorded as a video of toy-play or play-acting [15] to display the possible interaction patterns with the games and maintain a record of the experience.

2.3. Reporting and analysis

As the workshops conclude in the creation of videos where the ideas are acted out, data is created for use in analysis as a part of the workshop design. In addition to the videos, the differing workshop activities and how different design tools are made available are stored. The use of tools and the activities participants took part in provides insight into how the ideas were created and is presented in section 3 together with the resulting ideas. A narrative analysis of the generated videos themselves is presented in section 4. This style of analysis, grounded in generative semiotics [31], is chosen as it allows a systematic and in-depth engagement with the videos, despite their short length.

The research approach used in this paper can be distilled into the following steps:

1. Workshops are organised that include outdoor exploration and the use of ideation methods.

2. The workshops are concluded in such a way that resulting ideas are acted out and captured as videos.
3. The resulting ideas and the ideation methods that were used are described.
4. The resulting videos are analysed using narrative analysis.

3. Resulting ideas

In this section, the three ideation sessions and the resulting game ideas are presented. See Table 1 for an overview of the twelve ideas created in total, together with the ideation cards that were used by the group, the idea description, and themes that can be derived from the idea. The number of participants in each session is not always exactly the same as the number of participants in the outdoors activity. Specifically, there were more participants in the outdoors portion in sessions 1 and 2 compared to the workshop portion. There were also some participants at the session 2 workshop who did not participate in the outdoors activity.

3.1. Session 1

For session 1, 9 participants attended the workshop session. They were split into two groups of 4 and 5 participants, one using the Hybridex Deck [27] and the other the VNA cards [28]. Additionally, a selection of LEGOs, playing cards, pens and paper were made available to all.

Group one used the Hybridex Deck to guide their ideation phase. As a result, the group imagined a mixed-reality game which fostered forest engagement and helped players learn about wildlife and the complexity of the ecosystem. Players would use an app to scan plants found in the wild, identify the species selected, and learn about them. Each scan of a new plant would also grant the players some virtual "seeds" to be used in their own customised virtual garden. In that game space, the real plants' counterparts will grow and reproduce.

Group two used the VNA Deck to guide their ideation phase. In their final idea, a visitor arrives at a lean-to shelter in a forest. There they find a magic portal (a real-time video screen) that lets them travel through time to view different scenarios of the forest around them, as well as forests in other parts of the world through a network of connected shelters. Initially, the screen shows a dystopian future, in a destroyed forest. The players are then given tasks (e.g., trapping virtual invasive species with virtual fences) which, once completed, see the forest condition begin to improve. The final ideas of both groups were recorded as two short videos using LEGOs to visualise them (see Figure 3).

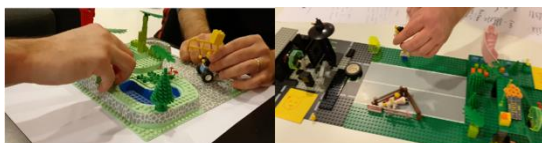


Figure 3: Session 1 games (group 1 on the left, group 2 on the right) recorded as LEGO play.

3.2. Session 2

For session two, 17 participants attended the workshop session, including three who joined only for that session. The participants were split into five groups of 3 to 5 participants, three used the Hybridex Deck [27] and two used the VNA cards [28]. Additionally, a selection of LEGOs, playing cards, pens and paper were made available to all. The groups developed the following ideas, one final idea per group (See Figure 4).

Group one used the Hybridex Deck. The idea is a 2-player console game or phone app. The player plays as a black grouse or hunter and moves around a board with flowers and obstacles. As a grouse, you get points when flowers are eaten. The hunter gets points from pointing a sword at the grouse. The game ends when the hunter kills the grouse by touching it. The final video of the game was acted out using Lego characters, flowers, and obstacles on a Lego board and included an audio description. Playful music was added to the video for effect.

Group two used the VNA deck. In the idea, a young couple battle a dragon to save their magical forest idyll. In the final video, the game was acted out using Lego characters. The game is story-driven and lights to create drama in the video.

Group three used the VNA deck. In the game, there are two players (Bob and Olivia). Each player finds geocaches and guesses whether the other player likes the geocache. If there is agreement, then they get points but no points if they do not match. At the end of the game if they do not meet a threshold then Bob has to pick flowers. In the final video of the game, the game was acted out using Lego characters and trees to depict where the geocaches are.

Group four used the Hybridex deck. In the resulting game, the player builds structures to protect the character from a dangerous typhoon that is approaching. In the video, the game was acted out using Lego depicting the structures and the typhoon.

Group five used the Hybridex deck. The game involves playing as a robotic ant that roams the forest collecting data. The video of the game was acted out using Lego to depict the character and the forest. A picture-in-picture mode is used to show what the character sees in the forest using a video of a real forest. Playful music was added to the video for effect along with text displaying the game name.



Figure 4: Session 2 games (Top left - Group 3, Bottom left - Group 4, Centre - Group 5, Top right, Group 1, Bottom right - Group 2).

Table 1
List of all resulting ideas.

Session 1			
Group	Card deck	Description	Themes
1	Hybridex	A digital gardening game which prompts players to go to a real forest and identify invasive species. Digital garden restored to former glory by removing invasive species in the real world.	Indoor-outdoor game, gardening, invasive species, environmental protection, real-world impact.
2	VNA	Portals connect forest recreation areas around the world. Augmented reality reveals a dystopian vision with invasive species behind players. Players collaborate on tasks to clear areas.	Invasive species, environmental protection, epic adventure, global village, collaborative games
Session 2			
Group	Card deck	Description	Themes
1	Hybridex	2-player turn-taking game involving a hunter and game bird. Points are given for tasks. The game ends when the hunter kills the bird.	Hunting, resource management, chasing, strategy game, role-playing
2	VNA	A young couple battle a dragon to save their magical forest idyll.	Forest peace and harmony, epic fantasy, action-adventure, love story, role-playing, conflict, environmental protection.
3	VNA	Two players find geocaches and guess whether the other player likes the geocache. Points for correct guesses. A threshold must be met to avoid punishment.	How well do you know your friend? Guessing game, geocaching, punishment, location-based game
4	Hybridex	The game requires you to build structures to protect your character from the approaching dangerous typhoon.	Climate change and mitigation, wild nature, human safety, adaptation, structure building, tower defence game
5	Hybridex	The game involves playing as a robotic ant that roams the forest collecting data.	Data collection, robotics, remote control, being in the forest remotely, sandbox game, simulation game
Session 3			
Group	Card deck	Description	Themes
1	Play potential	An app for creating an asynchronous nature experience by recording and mixing sounds at a location for sharing with others.	Mobile app, audio-based, asynchronous experience, social
2	Nothing specific	Tasks are given to the user to enjoy nature with e.g. hugging a tree or lying down on moss.	Tactile experience, quests, enjoying nature
3	Play potential	Information is conveyed on how feeding animals in the park can have bad consequences.	Learning, story, wellbeing of animals
4	Nothing specific	An app invites the user to be mindful with trees nearby.	Mobile app, mindfulness, relaxation, location based

3.3. Session 3

In session 3, participants were divided into 5 groups, each consisting of 3 to 4 members. The use of card-based methods in this session was not as integral to the process in this session as the previous sessions. Specific decks were not distributed to the groups, and they had the flexibility to use any cards from the three decks offered (VNA, HYBRIDEX, Play potential) and could also use the nature experience cards they were encouraged to create during the outdoors activity (see Figure 5). For creating the videos, the groups once again had access to LEGOs, as well as toys and objects that were found within the workshop location (See Figure 6). Additionally, they incorporated the outdoor elements into their videos.



Figure 5: Cards filled by participants.

Group one used the Play potential cards to aid their ideation. The idea is that it is possible to record and mix audio at specific locations and share the result with others. This is accomplished with a mobile phone application that is made as an asynchronous experience for the users. In the final video, a person walks on snow towards a hut. There is a puddle of water at the hut.

The person records the sound of light rain hitting the water and walks away. Group two did not use a specific card method. Their idea revolves around the idea of tasks being given to the user in order to promote enjoyment of the forest. In the final video, nature scenery is first shown, followed by cards with simple tasks (e.g. "hum a tune like the sound of your steps on the snow" and "lie down on a bed of moss") and then a doll is shown acting out these tasks.

Group three used the Play potential cards. Their idea is to warn about the dangers of behaving without better knowledge in the forest. In the final video, three birds are given a piece of cake by two elf dolls. Next, the birds die, and the elves realise that it is because of the cake.

Group four did not use a specific card method. Their idea involved creating an application that informs the user about places to stop and be mindful. In the final video, a person walks in the snow and their phone informs them that there is something next to them. The person then moves to relax in front of tree, and the video concludes with a view of the tree.

Group five did not use a specific card method. Their idea is to use a gamified application to sense the world

underneath the snow cover. In the final video, a Lego character moves on snow, also made of Lego. It is revealed that there are cavernous structures under the snow and even more things from the previous season hidden beneath the snow.



Figure 6: Session 3 games (Top left - Group 1, Bottom left - Group 3, Centre - Group 2, Top right, Group 4, Bottom right - Group 5).

4. Analysis

A simple narrative analysis was conducted, grounded in generative semiotics [31] on all the videos produced in the workshops. The analysis focused on their story arc (the initial situation, its development, and the ending), the characters (who are they and how do they relate to their environment and to technology), settings (what are the places that are represented and how is it done), values (what are the values embedded more or less explicitly in the story) and, lastly, the goal (that a character or the designer is trying to accomplish).

As the videos were short (between 0:20 - 3:03 minutes), analysis was conducted by watching the videos and reporting how the above categories appeared in them.

4.1. Analysis of concepts from session 1 (videos enacted with LEGO)

Group 1: In the story, an avatar is playing in a digital garden. They want the vegetation to be more varied. The player visits a forest in the real world, scanning plants to obtain digital seeds. The scanned flower reveals itself as invasive in both the game and real life. The player uproots it in both environments.

Characters: Only one human character, present in the game through a robot-looking avatar, and physically in the real world. **Setting:** Two settings: (1) a digital garden (represented as a playful space with weird sculptures and vegetation), (2) a Finnish forest (represented through a few elements: a tree, moss, and a flower). **Values:** (1) fun / customisation (the player enjoys taking care of the virtual garden), (2) enjoyment of nature (when moving in the real forest), (3) ecosystem integrity (removing invasive species from both environments). **Goals:** The aim of the game seems to be teaching about biodiversity and activating actions for removing invasive species.

Group 2: In the story, a forest visitor reaches a laavu (a forest shelter) and finds a magic portal which allows them to see a dystopian future. The player completes tasks with a friend (e.g. traps invasive species) and the future vision transforms into a better one. **Characters:** A forest visitor and a helper friend. Their opponent is some abstractly represented invasive species. **Setting:** A laavu in a Finnish forest, a digital representation of the future. The future is filled with unnatural elements, mostly black, which are exchanged with green colour and plants when it transforms. **Values:** (1) friendship (voiceover insists on collective action), (2) control (players fence off the invasive species), (3) ecosystem integrity (removing invasive species from both environments). **Goals:** The aim is to do multiple tasks with friends to improve the outlook of the area at the lean-to.

4.2. Analysis of concepts from session 2 (videos enacted with LEGO)

Group 1: In the story, the avatar of a hunter and a grouse move in a digital space. The grouse eats some flowers before being slain by the hunter with a sword. **Characters:** Two opponents: the grouse feeding on flowers and a hunter pursuing the grouse with a long laser sword. **Setting:** A digital space with maze-like qualities. The characters start at opposite sides of it. **Values:** (1) fun (it is presented as a game), (2) sustainability (voiceover stated the game aims at teaching sustainable hunting practices and Finnish culture), (3) Achievement (both characters pursue clear achievable objectives). **Goals:** Each of the two players in the game attempts to reach a win condition: the grouse eats flowers and reaches the top of the tree or the hunter kills the grouse.

Group 2: In the story, a boy and a girl want to live in peace in a magical forest, a dragon attacks them and attempts to destroy the forest. After a battle, they kill the dragon. **Characters:** There are two human characters working together. They are represented with LEGO bricks and their genders are coded with light blue and pink colours. The opponent is a dragon, also made out of LEGO bricks. The dragon fire is also represented with LEGO and highlighted with light effects. **Setting:** A magical forest is divided into two sides, one for each main character. There is a tower behind which the dragon is hiding and returns to die. **Values:** (1) companionship (the main characters want to live together), (2) harmony (they want a peaceful life in the forest), (3) valour (the story is about battles and might). **Goals:** The goal is for the boy and girl to defeat the dragon and conquer the forest.

Group 3: In the story, there are two friends, Bob and Olivia. Bob visits 5 geocaches and marks which ones he thinks Olivia would like. Next, they go together to the caches and score points if Bob's predictions are correct. The first two are correct, but not the third. To remedy this, Bob has to go into a pit and pick flowers for Olivia. **Characters:** Two human characters, Bob and Olivia collaborating. **Setting:** The setting is a forest, specifically five locations containing geocaches and a pit containing flowers. **Values:** (1) friendship

(the game is about testing one's knowledge about another person), (2) fun (the game is supposed to be fun to play). **Goals:** The goal of the game is to guess which geocaches someone else would like.

Group 4: In the story, a typhoon hit a coastal area. A 3D printer, created for this purpose, prints a bench that is both indestructible and reassuring (playing music and soothing messages) to protect a person there. The person is unaffected by the storm. **Characters:** The main characters are the designers that set up the 3D printer, not represented in the video besides in the voiceover. The main opponent is the typhoon, represented as a colourful LEGO tower. Only one human character is represented, as a passive entity being protected by the 3D printed bench. **Setting:** The setting is a beach (a shore in yellow and a sea in blue). On it, are two structures: a 3D printer and a bench (the latter looks like a bunker, both represented with very colourful LEGO pieces). **Values:** (1) Safety (the project is about protecting and reassuring). **Goals:** The goal is to protect people and help them survive a storm and feel safe.

Group 5: In the story, a robotic ant with a human driver moves across a forest collecting data. **Characters:** A robot-ant, composed of one vehicle with long antenna-like sensors and a human driver wearing a helmet. **Setting:** The setting is a forest, represented by a series of trees, leaves, and flowers, but also human-made fences. Some video footage of the forest excursion is visible in the top left corner of the screen and at the end of the video. **Values:** (1) Data (data collection is presented as an important endeavour). **Goals:** The goal is to scan the forest with the robotic ant.

4.3. Analysis of concepts from session 3 (live action videos and videos enacted with toys)

Group 1: In the story, Isabella hears some trickling water while on a stroll. She uses a phone app to record the sound and shares it with others (who can access and remix it via the app). She then continued her stroll. **Characters:** The only character present is Isabella. Other humans are inferred by the use of the app. **Setting:** A village covered in snow, featuring some far away trees and several wooden buildings. Water trickles from a cabin's overhang to a puddle below. **Values:** (1) aesthetics (the sounds of nature as a pleasurable aesthetic experience), (2) creativity (remixing and editing natural sounds), (3) sociality (sharing the sounds with others). **Goal:** To record, edit, and share soundscapes with others.

Group 2: A person is roaming in the forest and finds a series of invitations that suggest different actions (hug a tree, lay on moss...). She then does all those actions. She finally finds one last invitation telling her to keep enjoying the forest. **Characters:** The only character is one person, represented by a doll. **Setting:** A forest, represented with several pictures of trees and mushrooms, with some sticks and pinecones, and finally with a series of items (Christmas decorations, pieces of wood...). **Values:** (1) enjoyment (the value of the forest comes from the enjoyment of

it), (2) discovery (there are hidden clues to be found), (3) sensations (the game focuses on the sensations and feelings from interacting with the forest). **Goal:** The goal is to do activities that get the person closer to the forest.

Group 3: In the story, a child and a mother see some birds. They feed them chocolate cake and leave. The birds eat the cake and some of them die. The family returns, realises what they did and runs away. **Characters:** Characters include a child and a parent, represented by dolls, and three birds, represented by bird-shaped egg cups. **Setting:** A space hosting some trees, a rocky hill, and a yellow building. **Values:** (1) compassion (the characters decide to feed the birds as an act of kindness), (2) escape from consequences (while feeling guilty, the characters run away from the dead birds). **Goal:** Teaching people that feeding animals can be damaging.

Group 4: In the story, a person walks on a snowy path and stops when he receives a notification on their phone. Probably prompted by it, he then notices a tree at his left and approaches it. He then seems to meditate or pray next to the tree. **Characters:** A person acted by a human. **Setting:** A path near several trees. A bridge and some buildings are visible down the path. **Values:** (1) surprise (the character seems to enjoy being suddenly notified), (2) Mindfulness (the character eagerly engages in some meditative activity). **Goal:** To find places to relax in the forest.

Group 5: In the story a person walks on a snowy path and, thanks to some kind of application, can visualise patterns in the snow and even what is beneath it - flora, fauna, water, etc. **Characters:** A person represented as a LEGO figure. **Setting:** A snowy path and the layers beneath it. The layers are represented as a white snowy uneven surface with a small stream crossing it, and a green surface with some flowers on it. **Values:** (1) perception (the app allows us to see complexity under the surface), (2) mobility (voice-over explains that this could lead to new ways of moving things and people via water/snow). **Goal:** To discover what is under the surface of the snow.

5. Discussion

All three design days produced creative ideas on how to use technology for human-forest interaction and resulted in twelve distinct ideas captured in video format. The themes included learning, social interactions, hunting, resource management, forest peace and harmony, adventure, environment protection, conflict, geocaching, climate change, safety, mindfulness, robotics, and data collection.

There were differences in the composition of participants in the sessions. The first session consisted mostly of gamification researchers, the second session mostly of forest science researchers, and the third session was a mix of gamification researchers, forest sciences researchers and researchers from other fields. The sessions were also slightly different in execution, as there was more freedom for the participants in the third session.

In the first session, the groups chose to reflect on the negative consequences of direct, or indirect, human activity in the forest. This illustrates the

influence of the field trip discussions, which often focused on the impacts of invasive species on forest management and deforestation pressures.

In the second session with a larger number of groups, the themes were rather broad with many forestry-related themes appearing in the final game designs. Geocaching and data collection, themes that appeared during the field trip, were directly integrated into two of the ideas. The nature theme was present in all of the ideas. Also, themes relating to environmental protection and climate change were present. These themes were explored using a variety of game types including collaborative games, sandbox games, and role-playing games. Furthermore, many of the game designs used role-playing, fantasy, and epic adventure as part of their design.

In the third session, most participants focused on the human experiences of nature. All settings reflected some form of interaction with natural phenomena, and all reflected, in one way or another, values that included aesthetic enjoyment and creativity, felt connection with the forest, and insight beyond what the eyes can see. Even though the third idea aimed to minimise the harm done to wildlife, its tone was also very much focused on human enjoyment, as signified by the child's excitement and appreciation of the birds. The awareness that was the core of this idea was another prevalent theme—all other ideas included forms of noticing and being mindful of and with the forest.

In Session 1, the themes were focused on dystopian futures and technological advancements which may reflect on the gamification researchers' exposure to these themes in the games they work with. However, Session 2 seems to be more about enhancing existing activities or re-imagining them. The forest researchers are likely participating in these activities themselves, such as hunting, protecting forests from risks, measuring, and recreation. Session 3 is more diverse and has a stronger connection to mindfulness overall. This may be due to the mixed make-up of the group, but also the different workshop structure that emphasizes reflexivity exercises.

The outdoor activities worked well in connection with the workshop activities. Clear connections to the outdoor activities offered to the participants can also be seen in the produced ideas e.g. geocaching and a lean-to shelter as a game location appear in the ideas. Mindfulness and sensing nature is also a theme that was promoted through the cards participants filled out in session 3.

In general, all of the ideation methods were successful in helping the participants generate the ideas. The field trips, along with the stated goals and the backgrounds of the participants, directed the ideation process towards human-forest interaction, which was the main goal. As a result, all of the final ideas were very much grounded in this area. Although specific ideation cards work well when used, they might not be essential as there are a multitude of other tools available.

The analysis shows that three main types of narrative were presented. The most common is a "gameplay" type (displaying some sort of playful activity - like the hunting game). There is also a "scene" type (in which there are no important changes of

status, but more the illustration of some principle - like perceiving what is hidden under the snow), and a "story" type (where some events are narrated - as in the bird feeding video). The types of stories suggest a focus on technology-mediated interactions that generally have immediate and local effects - there is no representation of long or wide scale consequences. While this is probably due to the workshops' instructions, it could be important in the future, to incorporate a more systemic and ecological layer to the reflection. Interestingly, many of the stories featuring non-human characters had to do with killing them, either voluntarily (in the hunting game and the dragon battle) or involuntarily (the birds killed by cake). This observation is somewhat surprising: despite the attempt to be conscious about nature in the walks and workshops, it seems that transcending an antagonistic relationship with non-human creatures has not been fully realised.

The characters are predominantly humans, or humans augmented with technology (game avatars). Non-human characters are only mentioned or have limited agency (the birds that eat cake and die), with the notable exception of the grouse and the dragon (both of which are killed, and the dragon is an unnatural character). Most stories feature only one or two characters, generally already related (friends, family). This suggests a perception that interactions with forests and nature are a privileged space, where social bonds among humans are reinforced or enjoyed. This could, in part, be attributed to the forest excursions that preceded the workshops. In the future, it may be important to expand the stories to encompass larger social groups and include non-human characters.

All of the settings in the videos represent environments with strong natural components (forests, paths, shorelines). In some cases, these are mediated or completely virtual spaces. The elements used to represent these spaces are limited, and include a green base (representing grass), trees, moss, flowers, snow, and streams/puddles. Most spaces contain only very few of these elements (between 3 and 7) to symbolise large natural spaces. The elements generally have no specific significance but are generic indicators of "nature". Most environments also include some traces of human activity, such as structures or vehicles. The repetition of elements, and the insistence on certain items (several videos contain some form of interaction with flowers) can be due to the toys available to the participants. Many of the interactions and apps appear to be adaptable to many spaces, so that the specificities of a place are not taken into account, in order to, instead, maximise adaptability.

The values represented in the videos are many. Some are explicitly included by the creators (like friendship or ecosystem integrity) while others are implicit, and possibly undesired (like control or escape from consequences). Interestingly, many videos featured values related to "fun", "surprise", "enjoyment" and "aesthetics" and then connected them to values or behaviours related to care for natural spaces or with well-being. The key strategy of many of the videos, then, seems to be related to the idea of gamification, in which a series of hedonistic experiences are used to promote specific behaviours -

in these cases relating to pro-social, healthy, and nature-caring actions. The goals presented in the videos often explicitly highlight this exact connection.

6. Conclusions

The way the three design days were structured, with outdoor activities and collaborative workshops, proved to be effective in directing participants' creative efforts towards genuine and pressing issues in the forestry sector, as well as towards a focus on well-being. The approach was accessible enough for everyone to participate, and all groups were successful in producing a video that captured their idea. The videos manage to take what would regularly be a textual representation of the idea into a more tangible audio-visual representation that effectively communicated and saved the produced idea. Effective communication is key when moving from an idea to an implementation.

Based on these findings, future efforts in designing playful systems for human-forest interaction would benefit from a similar approach, since forest play and informed discussions in combination provided a strong foundation for creative undertakings.

Still, there are also limitations to this approach. Specifically, the solution is currently reliant on participants being able to be physically present at a location that is suitable for driving ideation. This limitation could potentially be mitigated through the use of virtual reality solutions. Another limitation of the study itself is that all of the participants were somehow engaged in academia. It is not possible to conclude how the approach would work with a different participant demographic.

There are many potential future directions for this work, e.g. (1) implementing designs based on the findings, (2) conducting more workshops with a similar setup within the same topic area or a different one, (3) conducting the workshops partially in virtual reality in such a way that it is not necessary to visit the actual on-site locations, and (4) improving the workshop method and creating more specific guidelines into organising such workshops.

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