



A Board Game and a Workshop for Co-creating Smart Nature Ecosystems

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Abstract. Younger generations from urban areas spend an increasing amount of time indoors with technology, e.g., with mobiles. GEKI is an exploratory project that investigates how to co-create with younger generations smart nature ecosystems and get them to spend time outdoors. This paper presents the design of a novel board game and a workshop with it for co-creating such an ecosystem with children.

Keywords: Nature · Children · Workshop · Smart ecosystem · Board game

1 Introduction

Experimental research shows that involving children in outdoor activities in nature is important for their development, and leads to many proven benefits. Firstly, it leads to pro-environmental behaviours, independently of whether children participate in wild environments, or “domesticated” natural environments like parks (e.g., [1, 16]). It brings resilience to stress and adversity [4] and improvements in mood of teens [11]. Time outdoors also positively affects physical well being [3]. On the contrary, lack of time spent outdoors in nature can result in mental and physical health issues, e.g., children with Attention Deficit Hyperactivity Disorder (ADHD) who play regularly in green play areas show milder symptoms than those who play in built outdoor and indoor settings [15].

Unfortunately, the quality and amount of time children from urbanised areas spend in natural outdoor environments are dramatically changing. These children tend to spend much more time indoors than outdoors—within schools, childcare centres, gym facilities and vehicles—to the point that Louv refers to them as children with a “nature deficit” [12]. The increased usage of technology for indoor activities, for watching TV, surfing the web, playing video games, is often blamed as one of the main causes of children’s living indoors. However,

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causes are complex, family and society-driven, as indicated in a recent survey of the National Wildlife Federation [5]. Technology, concludes the survey, can be beneficial but it has to be differently used in nature than nowadays. The Get-Out-Kids-and-Interact (GeKI) project considers such concerns and sustains the design of novel smart nature ecosystems with and for children.

GeKI has started investigating how to engage children in the design of novel smart nature ecosystems for them. To this aim, it has created a board game, the Nature Board Game, for children. By playing the game, they learn how to co-create interactive objects for such ecosystems. The paper starts presenting related work in the area of interaction design and children. Then it explains the conception and latest evolution of the game, as used in a workshop with children. Results of the workshop are used to reflect over the idea of a board game for engaging children in the design of smart nature ecosystems for them.

2 Related Work

Research in Human Computer Interaction (HCI) is considering how to design technology that brings children outdoors and adds instead of subtracting from the experience, e.g., see the CHI 2018 workshop [9]. The shared view is that technology should be differently designed for outdoors activities in nature, so as to make children reconsider spending time outdoors. Anggarendra and Brereton consider this to be a prominent research direction: in their conclusions to their HCI literature review [2], they sustain that HCI research for outdoors natural environments should not only be concerned with sustainability issues, but it could also be concerned with engaging people to spend time outdoors per se.

Participatory design or co-design more in general strive to enhance environments where people live by engaging them in designing or re-designing the environments themselves [14]. Although there are several participatory or co-design workshops with cards or other generative toolkits for designing smart or IoT objects with children, e.g., for enhancing cities [13] or for creating socio-emotional bonds [7,8], there are fewer workshops for co-designing with children smart nature ecosystems. An exception is by Smart Toy LLC, which partnered with the National Wildlife Federation in USA to create a mobile gamified app and a companion smart toy that encourage USA children to connect with nature [10]. The design of their solution started with a qualitative study and a participatory workshop, which asked children to imagine their toys “to help others like them to connect with nature”. Results of the workshop were paper-based prototypes. The research of GeKI, reported in this paper, moves from similar ideas but goes one step further. It aims to co-create smart nature ecosystems with children by playing with them. The first step in the research is the creation of a board game for co-creating with children, and its usage in workshops with children. Its design and usage are unravelled in the remainder of the paper.



Fig. 1. Deck of Nature Cards, consisting of: Environment Cards (top two rows); Input Cards (middle two rows); Output Cards (bottom row)

3 Board Game

The *Nature Board Game* is a collaborative board game that takes place in the central park of a city, which is immersed in nature. Its goal and how to win it, roles of players, material and rules are described next.

3.1 Goal and Roles

The game is designed for 2–4 players, who are children older than 8, and a person with expertise in interaction design. This person plays the role of *Mayor*. The Mayor wants to organise a festival for children, and needs help to make the park “smart”, by enhancing it with interactivity. Players act as *designers* of the new smart nature ecosystem. The game terminates when the goal is reached: each player has created (at least) an interactive object for the park.

3.2 Material

The game per se consists of a Game Board (see Fig. 2), 4 Mission Cards, 1 Mission Board, 4 Tokens, a deck of Nature cards, 1 Table with all the available cards (see Fig. 1), Coins, 1 Dice, 4 Note Sheets and 1 one-minute Hourglass. The deck of Nature Cards consists of: 18 Environment Cards concerning Nature elements or outdoors elements of parks that children can make interactive, e.g., a tree or a swing; 20 Input Cards, concerning triggers for Environment Cards, such as, light sensors; 5 Output Cards, concerning reactions related with Environment Cards, such as lights or sounds.

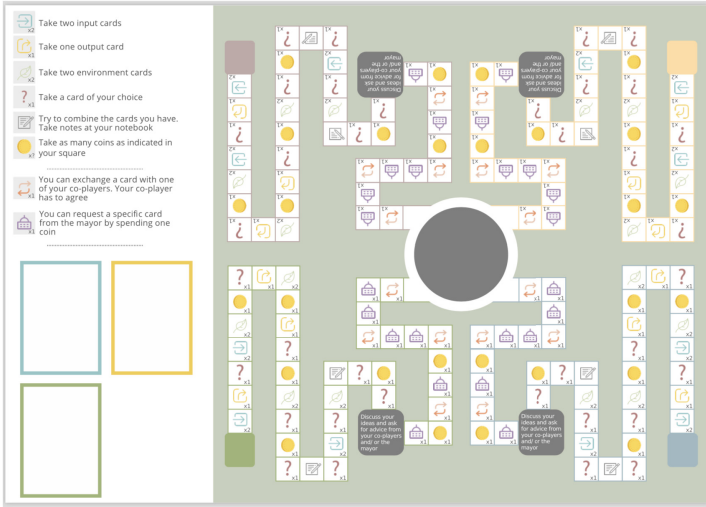


Fig. 2. The board game

Each player takes a note sheet and a token. The *Mayor* keeps a copy of the cards of each category and the coins. The rest of the cards are placed shuffled and faced down on the game board at the corresponding category spot.

3.3 Rules

The *Designers* should carry out one out of the following four missions: (1) add playful and interactive attractions to the park, (2) help visitors explore hidden spots of the park, (3) make sure the visitors respect the park during and after the festival and (4) make sure the park is accessible to everybody. Once a mission is decided with the Mayor, each player places his/her token at a different colorful square (see Fig. 2) and tries to reach the central circle of the board.

Each player, in turn, throws the dice and moves the token the number of spaces indicated by the dice. Depending on the space the token reaches, the player may be entitled to get one or more cards from the piles of cards, get coins, try to combine the cards and take notes, exchange or buy a card. Each time a player’s token lands on the notebook space, the *Mayor* turns the hourglass and all the players individually should start thinking of how to combine the cards they already have. They place the cards they do not need on the corresponding place on their note sheet as an indication that they are willing to exchange them. They can also refer to the all-cards table to note down the extra cards they may need. The note sheet and the all-cards table can also be used individually at any time during the game. Among the cards there are blank cards. If a player receives a blank card, he can use it as any other card of his/her choice from the same category.

When a player lands on or passes over the grey square in the middle of his/her path, he/she has to stop there and wait until all the players reach their own grey square. When all the players have reached this point, they have to present in turn their ideas to the rest of the team and the *Mayor*. Each one of the other players should give their opinion and advise the player on how to improve his/her idea. In the end of each turn, the *Mayor* gives the final advice to the player. At the end of this part, each player should have more or less shaped an idea about his/her interactive object and designated on the possible missing cards. After the end of the discussion part, the players keep on moving towards the central circle. When a player lands on the exchange icon, he/she can either exchange or buy a card from another player. When he/she lands on the city-hall icon, he/she can buy a card from the *Mayor*. Each card costs 1 coin. When all the players have reached the center, they should present their final interactive objects with the corresponding cards to the *Mayor* by placing them to the mission board.

4 Workshop

The game was tested and iteratively refined by playing it in 4 main pilot workshops: one with 5 adults, all experts of interaction design; two workshops with 2 11-year-old children and 2 adults with expertise in interaction design; 4 engineering and design students, participating in the Interaction Design Masters course of Milan Polytechnics. Those workshops served to prepare the groundwork for the co-creation workshop described in the remainder of this paper.

4.1 Workshop Description

Exploratory Research Questions. This workshop aimed at exploring whether the board game (1) is understandable for children, (2) is engaging, (3) elicits children's ideas concerning interactive objects for nature outdoors environment.



Fig. 3. Participant players write down their ideas after the completion of the game

Participants and Setting. A workshop was conducted in a house and involved 4 female children, 10–13 years old, one designer, acting as Mayor and moderator, and one instructor experienced in technology-based workshops with children, acting as observer. It lasted circa two hours. All children participated on a voluntary basis and their participation was asked through a consent form.

Protocol. Before starting the game play, children were asked whether they use technological devices in their everyday life and their experience with co-creating interactive solutions. A brief oral presentation was made introducing the definitions of interactive objects, input/sensors, output/actuators and the goal of the workshop. Then the game-play started, divided into two main parts. In the scaffolding part of the game, the input and output cards and the board game were presented and explained to the children. As a first step, the children were asked successively to choose a random card and try to think of what it represents. In case of difficulty in understanding it (e.g., motion input card), the Mayor, acting as moderator, suggested to re-read the description under the title. As a second step, she asked them to take randomly one card of each category and try to think of an interaction scenario. During the game-play part, the game rules were explained and players were given the necessary materials to start. After the completion of the game, the players presented their interactive objects to the Mayor. They were also asked to write down their ideas (see Fig. 3). As a last part, a post-game discussion was held among the players, the Mayor and observer about the game. Players were asked whether they understood and enjoyed the game, as well as to give suggestions for changes.

4.2 Workshop Results

Data related to understandability of the game, engagement with it and ideas emerged from the game play were collected via observations by the moderator (acting as Mayor during the game play) and the observer, as well as via oral questions during the workshop. The moderator and the observer collected their observations independently and then compared their notes, resolving doubts through discussion. Photos were also used to document significant moments. Data are reported below divided per game part: scaffolding; game play.

All players answered that they use technological devices like mobile phones and tablets almost everyday. Two of them (3rd and 4th player) had previous similar experience with robotics workshops. According to the gathered data, nature cards were interpreted without particular problems, especially after reading their description in case of doubts. Among the ideas that came out during the scaffolding part were: a trampoline that lights up when someone jumps on it (*Speed* input card, *Light up* output card), a bird house that vibrates when the bird approaches it (*Distance* input card, *Vibrate* output card). According to the observer and moderator, the scaffolding part helped children break the ice and get them engaged in the game. The players with previous experience seemed more confident during the whole game and helped the others at point, e.g., the former players both made suggestions to the other players.

Table 1. Interactive object ideas.

Players	Interactive objects
1st player (13 years old)	<i>I have a bike; when it goes fast or when I push a button on it, it plays music</i>
2nd player (11 years old)	<i>I am next to a street light that makes a sound when the temperature is high</i>
3rd player (13 years old)	<i>The fence has a camera; when it detects people, music is played. The fountain is illuminated with colourful water; when it recognises a colour, a video is projected through water, showing several natural phenomena</i>
4th player (10 years old)	<i>When you push the button on the fountain, its lights shine. When the fence has a certain color, it lights up. When the fountain rotates, a light shines</i>

During the game play, all players showed a good level of enjoyment and overall engagement. Each managed to collaborate and to present at least one idea to the moderator (see Table 1). Mission cards, in particular, were not used in a restrictive way and, in the end, the players seemed to have completely forgotten about them. The final ideas were simple and were mostly based on describing the interaction of few Input/Output Cards with Environment Cards. The suggestions by the children for improving the game were to add more players, more colors, more boxes, a background with trees “to suggest that we are in a real park”, and places to illustrate their ideas. Results of the workshop and directions for future work are briefly reflected over in the conclusions.

5 Conclusions and Future Work

The paper reports on the design of the Nature Board Game and its usage in a workshop with children. On the one hand, results of the workshop are limited by its contextual nature, and the fact that it involved only girls. On the other hand, they suggest that children without any experience can understand and engage in the game, and succeed in co-designing interactive objects for smart nature ecosystems. Such objects are however rather simple from the interaction viewpoint.

Based on the observations and players’ proposals, on-going work aims at designing a novel version of the game which can further guide children in the construction of smart nature ecosystems. The novel version is divided into different complexity levels. The first level serves to immerse children into the park and explore the usage of cards. Specifically, the first level shows a park with trees to give the feeling of being in nature, as suggested by children. The first level also, with the use of videos, guides children to explore the usage of cards in predefined complex smart objects for nature ecosystems. The other levels instead

guide children in their co-construction of their own objects with the Mayor. The final level, in particular, enables children to store their ideas in digital format.

Therefore the board game is turning into a hybrid board game, mixing the physical and the digital, and hence facilitating the sharing of children's novel ideas with other children so as to enable, besides different user classes (like in [6]) collaborative co-design, also their collaborative co-evolution.

References

1. Andrejewski, R., Mowen, A., Kerstetter, D.: An examination of children's outdoor time, nature connection, and environmental stewardship. In: Proceedings of the Northeastern Recreation Research Symposium (2011)
2. Anggarendra, R., Brereton, M.: Engaging children with nature through environmental HCI. In: Proceedings of the 28th Australian Conference on Computer-Human Interaction, OzCHI 2016, pp. 310–315. ACM, New York (2016). <https://doi.org/10.1145/3010915.3010981>
3. Calogiuri, G.: Natural environments and childhood experiences promoting physical activity, examining the mediational effects of feelings about nature and social networks. *Int. J. Environ. Res. Public Health* **13**(4), 439 (2016). <https://doi.org/10.3390/ijerph13040439>
4. Corraliza, J., Collado, S., Bethelmy, L.: Nature as a moderator of stress in urban children. *Procedia Soc. Behav. Sci.* **38**, 253–263 (2012). <https://doi.org/10.1016/j.sbspro.2012.03.347>
5. Coyle, K.: Digital technology's role in connecting children and adults to nature and the outdoors (2017). https://www.nwf.org/~media/PDFs/Kids-and-Nature/NWF_Role-of-Technology-in-Connecting-Kids-to-Nature_6-30_lsh.ashx. Accessed Sept 2018
6. Di Mascio, T., Gennari, R., Melonio, A., Vittorini, P.: The user classes building process in a TEL project. In: Vittorini, P., Gennari, R., Marenzi, I., de la Prieta, F., Rodríguez, J.M.C. (eds.) *International Workshop on Evidence-Based Technology Enhanced Learning*, pp. 107–114. Springer, Heidelberg (2012)
7. Gennari, R., Melonio, A., Rizvi, M.: The participatory design process of tangibles for children's socio-emotional learning. In: Barbosa, S., Markopoulos, P., Paternò, F., Stumpf, S., Valtolina, S. (eds.) *Proceedings of the 6th International Symposium on End-User Development (IS-EUD 2017)*. LNCS, pp. 167–182. Springer, Cham (2017)
8. Gennari, R., Melonio, A., Rizvi, M., Bonani, A.: Design of IoT tangibles for primary schools: a case study. In: Proceedings of the 12th Biannual Conference on Italian SIGCHI Chapter, CHIItaly 2017, Cagliari, Italy, 18–20 September 2017, pp. 26:1–26:6 (2017). <https://doi.org/10.1145/3125571.3125591>
9. Jones, M.D., Anderson, Z., Häkkinä, J., Cheverst, K., Daiber, F.: HCI outdoors: understanding human-computer interaction in outdoor recreation. In: Extended Abstracts of the 2018 CHI Conference on Human Factors in Computing Systems, CHI EA 2018, pp. W12:1–W12:8. ACM, New York (2018). <https://doi.org/10.1145/3170427.3170624>
10. Koepfler, J.: Connecting children with nature through smart toy design (2016). <https://www.smashingmagazine.com/2016/07/connecting-children-with-nature-through-smart-toy-design/>. Accessed Sept 2018

11. Li, D., Deal, B., Zhou, X., Slavenas, M., Sullivan, W.C.: Moving beyond the neighborhood: daily exposure to nature and adolescents' mood. *Landsc. Urban Plan.* **173**, 33–43 (2018)
12. Louv, R.: *Last Child in the Woods*. Algonquin Books (2005)
13. Mavroudi, A., Divitini, M., Gianni, F., Mora, S., Kvittem, D.R.: Designing IoT applications in lower secondary schools. In: 2018 IEEE Global Engineering Education Conference (EDUCON), April 2018, pp. 1120–1126 (2018). <https://doi.org/10.1109/EDUCON.2018.8363355>
14. Sanders, E.B., Stappers, P.J.: Co-creation and the new landscapes of design. *CoDesign Int. J. CoCreation Des. Arts* **4**(1), 5–18 (2008)
15. Taylor, A., Kuo, M.: Could exposure to everyday green spaces help treat ADHD: evidence from children's play settings. *Appl. Psychol. Health Well-Being* **3**, 281–303 (2011). <https://doi.org/10.1111/j.1758-0854.2011.01052.x>
16. Wells, N.M., Lekies, K.S.: Nature and the life course: pathways from childhood nature experiences to adult environmentalism. *Child. Youth Environ.* **16**(1), 1–24 (2006). <http://www.jstor.org/stable/10.7721/chilyoutenvi.16.1.0001>