
Designing Children's Digital-Physical Play in Natural Outdoors Settings

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Abstract

Children's outdoor play is fluent and fluctuating, shaped by environmental features and conditions. The article reports on a project where interaction designers and landscape architects work together to develop solutions for integrating interactive play in outdoor environments. Here we report on a schoolyard trial, where interactive play technology was installed as an integral part of the schoolyard environment, and discuss the interplay between technology and the environment. We highlight in particular how the interactive technology contributed to the versatility of play activities, but also how the nature setting and the availability of natural materials contributed to the play activities around the interactive artefacts.

Author Keywords

Interactive play; playscape; landscape architecture

ACM Classification Keywords

H.5.m. Information interfaces and presentation: Misc.

Introduction

Outdoor play is typically considered an essential, healthy and desirable activity for children [4], especially in its capability of encouraging physical activity. Yet, studies have shown that children spend less time outdoors than previous generations [5]. While

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Figure 1: The tube.



Figure 2: One of the communication nodes (mountain setting).

the impact of this on children's physical activity has received much attention [17], its impact on imaginary play may be even more severe [5, 16].

One reason for the decline in outdoor play is the increased access to screen-based activity in the form of TV, Internet and computer games [16, 20]. But in addition, the urban landscape is increasingly designed as if children would only play in designated playgrounds, designed to offer safety and seclusion. Many residential areas today include little support for children's play and the general urban outdoor environment is not always child-friendly. Incorporating technology in the outdoor environment is a potential way to combine social and physical advantages of classical outdoor play with the appeal of computer games [16, 20, 18], thus making outdoor play more attractive to children again [20].

An interactive playground is commonly defined as a space in which physical play objects that are augmented with digital technology stimulate play [20]. The project, DigiFys, seeks to go beyond this approach, to develop suburban play landscapes with integrated interactive components as a way to address the increasing scarcity of play spaces in the urban landscape. These spaces make autonomous everyday play more accessible for children.

The investigation is a collaboration project between interaction designers and landscape architects, while semi-generic, the approach strives to make interactive technology completely integrated with a specific place. Hence, understanding affordances and opportunities offered by the place itself is an essential part of the

design process, as is understanding the lifestyle and culture of the children residing in the area.

Background

Outdoor play tends to be more mobile and physical than indoors play, but follows the same general development patterns [13]. Detailed studies have focused on the effects on play by playground design (see Barbour [1] for a literature overview). Access to nature and natural materials is often considered a crucial part of the outdoor experience [24]. Talbot and Frost [21] coined the term 'Playscape' as a way to think about how a particular landscape can afford play and what they call "magical thinking". In her detailed study of outdoor play in a natural forest, Fjørtoft [9] discusses how the shrubbery affords both hide-and-seek as well as imaginative play (e.g. playing 'house'), whereas more sturdy trees would afford climbing and open spaces running and games of 'tag'. Retaining a natural landscape in for example school grounds has been found to increase the amount of play activities pursued by children in general, not only in the natural landscape but also in adjacent hard-made areas [12].

Research projects have often focused on supporting open-ended and creative play through more open-ended designs rather than implementing specific game challenges. De Valk et al. [6] propose a design strategy towards 'open-ended play'; play activities that are guided, but not constrained, by the designed artefacts. According to the authors, players that engage with open-ended installations go through a three-stage process of accepting the invitation, exploring the opportunities and subsequently immersing in the play activity [6, 7]. With a sufficiently rich and suggestive installation, the play activity may shift back and forth



Figure 3: The installation places (top, photo). The chosen spots lie close to, but not exactly at, the favorite play spots as indicated by children (bottom, map).



Figure 4: The tube installed at the water location.

between exploration and immersion. Very similar design principles have been articulated for playful art installations in public space [15].

Work in the field of playgrounds, where interactive play technology is considered in a spatial context, is still often based on user studies with specific interactive play objects. The influence of the environment plays a subordinate role in such work. Especially, the user studies on interactive playgrounds rarely take place in an actual outdoors playground setting but rather in gyms, [7, 8, 23] or even lab settings [22], neglecting the influence of the environment on play. Many studies on interactive playgrounds in outdoor settings also primarily focus on the digital props and the isolated play with them [11, 12, 19]. Previous example projects that do take the environment into account include Seitinger et al. [18] who focus on the relationship between children and the play environment as mediated by animated playground props and the Water Games presented by Pare's et al. [14] where the spatial component of play is explicitly considered.

DigiFys – Designing for Outdoor Play

Capitalizing on both interaction design and landscape design, the DigiFys project proposes to focus on children's immediate surroundings. Through landscape design, it is often possible to re-purpose spaces for multiple uses, including recreational, social and playful. Through the introduction of interactive play technology, the places are further enhanced to offer rich and varying play activities. The reported study is targeting a schoolyard environment, which is an important environment for children's everyday play but also must cater for other activities, most notably organized physical education. The project uses a multi-disciplinary

approach, combining elements both from landscape architecture and interaction design. These methods are at the same time complementary and sometimes conflicting.

The prototypes presented below are the first fully functional prototypes developed in the project as a result of an iterative design process. The focus was on creating a design solution that would support open-ended play [6] and that would be integrated in the landscape. The design was guided by results from several children-led walks [3], to understand childrens' experiences, preferences and play patterns at the yards at their different schools. The very early prototypes were trialled with invited children in a lab environment staged to mimic an outdoor location to validate the affordances and play value of the prototypes. After this, a second round of trials were done outdoors, but again in a staged environment (this time in a park) with invited participants. The full development process is reported in two master theses [10, 17].

Artefact and Installation Design

The interactive artefacts developed in the project share common design goals: they are designed to invite open-ended play [6], to be possible to integrate in the landscape and the tube affords using available materials such as sand, stone, sticks and water. In the schoolyard trials, two prototype designs were used in different versions and settings at the schoolyard.

The tube

The *tube* prototype is shown in Figure 1. The tube registers when objects are being put through and can recognize certain qualities of the objects. Feedback is provided by the tube itself, but was also integrated into



Figure 5: The communication node at the water.



Figure 6: The two portable nodes. The tube in the background, the communication box in the front.

other elements of the installations in the form of sound and light. Physically, the tube is a square shaped wooden shaft. The length and other form factors of the tube can be adapted to the location where it is installed. Each tube is equipped with several sensors, sensing the different qualities in the objects being thrown through the tube: liquidity, vibrations (usually related to weight), and an infrared-barrier that is triggered for most objects that pass through the tube. The tube projects a continuous soundscape around it, that gets more intense as the tube is used more and tunes down when the tube is used less. Each sensor also triggers its own sound. Visual feedback was mounted on the tube itself, and takes the form of a sequence of RGB LEDs on the top of the tube reacting differently to the different qualities.

Communication nodes

The communication nodes are shown in Figure 2. The communication concept was intended to enable children to communicate verbally with children in other places. In the trial three communication nodes were used that differed in visual appearance and form factor, to inspire multiple forms of interaction with the nodes. The functionality of the controls was identical for all three communication nodes. Each communication node has two call buttons, each corresponding to one of the other two nodes. When a button is pushed, the communication channel to the respective node is opened. The state of the communication is conveyed through both light and sound effects.

Installing into the environment

While the interactive designs offer some inherent play opportunities, their purpose is to be integrated into an outdoor environment. The tube is specifically designed

to interact with natural materials such as water, stones, twigs and pinecones. In the chosen schoolyard multiple play areas with different landscape characteristics existed, including a natural forest and more traditional paved and sanded areas.

The locations chosen for the installations are depicted in Figure 3. Two settings were selected for the installations: a 'mountain setting' located high up on a hill in the forested area of the school yard, and a 'water setting' located in an open area in direct conjunction with a small water canal that runs through the school yard. The mountain setting was located in what the children call 'the forest', a popular area for fantasy play and building huts. The 'water setting' is partly in the constructed part of schoolyard, right at the forest border. Both locations were equipped with a tube (Figure 4) and a communication node (Figure 5). For comparison, two portable versions of the tube and the communication node were also created (Figure 6). Their portable format allows them to be carried around and increase the children's opportunities to create their own playscapes around the prototypes, which provided a useful comparison to the two fixed installations during the study.

Study Setup, Observations, and Analysis

The evaluation comprised of four days of direct observation while the children in the school were offered free access to all of the installations during their normal recess time in the schoolyard. The observation notes were map-based to also capture location data, and were guided by the following three questions: 1) *What type of play happens in the school yard?* 2) *How does the landscape with our prototypes affect the play?* 3) *How is natural material used in the play?* The



Figure 7: De-clogging the mountain tube.



Figure 8: Running up and down, and playing in both ends of the tube.

material was analysed informed by location of play, as well as play categories from de Valk et al. [7]

Results and Discussion

The results show that the affordances of the landscape surrounding the prototypes defined the play patterns that appeared in multiple ways. In particular, the physical shape of the landscape, and the availability of natural materials shaped the play. Results also show that the interactive prototypes invited children to explore them to a large extent and to play in the area surrounding the prototypes.

We could see that the installations presented attractive invitations to play. Typically, children would start to play when they heard action-triggered sounds, be it a communicated message or the sound feedback from a tube or a communication node. The physical appearance of the installations also functioned as invitation, in particular with the mountain setting. Finally, the installations feature a 'honeypot effect' [2], children playing with an installation function as a strong attractor for other children. The honeypot effect was enhanced by the way most of the installations used sound to communicate play intensity.

The design of the mountain tube, together with the affordances of the steep slope of the mountainside and loose forest materials, made the play with this tube very physical. The children were using hands, arms, feet and legs to try to push stones through the tube, to de-clog it and to excite the sound and light feedback (Figure 7). The typical play pattern around the mountain tube was a distributed activity around the lower and upper ends of the tube (Figure 8). One or more children were putting in objects at the top, while

another group of children were at the bottom to return the material as it came out of the tube.

The communication station invited children to speak and sing into it and giving speeches. This was all part of the performative play in this stage-like place on top of the mountain where the station was placed. Often the communication led to physical movement between the communication nodes as children ran between them to talk.

The setting and design of the water communication node, with rings high up above the heads of the children, resulted in imaginative play (see Figure 5). Play was also based on the affordances of the buttons, in a way totally disconnected from the communication concept. The buttons were used to jump on, to stand and to sit on. Placing two large buttons next to each other invited children to do synchronized activities on both buttons: Jumping at the same time, playing air guitar together or switching positions from one button to the other at the same time.

The interactive installations also affected, and inspired, play activities in the surrounding landscape. Sometimes children, mostly girls, would be sitting under the speakers, listening to the bird calls and the changing weather conditions. On one occasion, a group of boys was playing in a hut in the forest close to the tube, using the sound as a background affecting happenings within their play.

However, sound effects were also sometimes problematic and caused disruptions in nearby play. On one occasion, whenever there was a call, one child went to answer, but would just say "Hi!" and then

return to his play with the rest of the group. Another similarly only answered "Shut up!". The prototypes coerced them into responding, but this engagement was reluctant and as a result, no communicative play emerged.

The portable prototypes featured some modes of play that were unusual for the fixed installations. Both the portable tube and the communication box tended to be used by only one or a few children at a time, thus primarily supporting solitary play and seemingly a feeling of ownership (see Figure 6). The mobile prototypes proved to be better suited for imaginative play than the fixed installations, and the children that developed immersive play strategies came back to play with them repeatedly on different breaks and days.

Conclusion

The schoolyard study presents many important insights concerning the integration of interactive technology into a playscape. We saw in particular that interactive technology is good at presenting play invitations, and that it is possible to capitalize on sound and light to this effect.

In literature on interaction design for play, it is common to look upon long-term engagement as the end goal of any interactive design. In our observations, we found digital installations to be effective in offering invitations, in particular through sound. We were also able to observe a wide range of functional and explorative play, while immersive play was uncommon. This should not be seen as an indication that the designs were unsuccessful, but is typical of how play activities are shaped by schoolyard environments as well as designed playgrounds, with their time limits for

play (school breaks and parent's schedules). In such settings, successful design is one that offers *recurring* play, when children come back to an installation over and over again, during the same visit or multiple visits.

The long-term goal of DigiFys is to develop strategies for making interactive technology truly embedded into the landscape of the play environment. The observations present some indications as to how the playscape may be enhanced by this approach. In particular, adding interactive elements to the landscape can increase the versatility of a location. Through interactivity, the locations are enriched to support a wider range of play activities than before. While nature offers versatility in and of itself, the neighborhood close to home that DigiFys targets is typically much less versatile. The schoolyard studies give us reason to believe that an integrated design approach to landscape architecture and interaction design will be able to provide a rich play environment also in such settings.

The schoolyard trials have highlighted the dilemma of at the same time designing artifact-centered interactivity with the more holistic perspective of designing the playscape. The studies elicited some first steps towards addressing this dilemma and future research will focus on further integrating the design activities by landscape and interaction designers.

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