DESIGNING FOR PLAYFUL EXPERIENCES IN OPEN-ENDED INTELLIGENT PLAY ENVIRONMENTS

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ABSTRACT

This paper describes an explorative study with an open-ended play environment. An initial interactive design, called FlowSteps, was developed for children aged 7-8 years old. This design was aimed at supporting the playful experiences of curiosity, exploration, challenge, fellowship and competition during three different stages of play: invitation, exploration and immersion. FlowSteps was evaluated with twenty children playing in pairs with the design. Results show evidence of the playful experiences supported by a variety of design elements over the three stages of play. We propose that these insights can help the development of playful, interactive designs for open-ended play.

KEYWORDS

Open-ended Play, Playful Experiences, Stages of Play, Design Research.

1. INTRODUCTION

Play is an important aspect of children's lives. It helps children in practicing new skills and exploring imaginary worlds (Acuff & Reiher 1997). Within play, a temporary world can be created with dynamic boundaries and rules (Huizinga 1955). Our research focuses on supporting social and physical play by offering children open-ended play designs that challenge them to come up with their own games (Bekker et al. 2010). This paper explores how to design for playful experiences within an open-ended play environment.

When designing for open-ended play, we actually design for an experience. Korhonen et al. (2009) have identified twenty playful experiences based on literature study and empirical research with videogames. The aim of these playful experiences is to support development of more playful interactive designs. Additional research is needed to understand how to apply the playful experiences in the design process.

In his work on interactivity and play, Polaine (2010) describes the experience of interaction as a process that goes through several stages, based on the four modes of interactivity (Salen & Zimmerman 2003). The experience starts with an invitation to play (first mentioned in Pesce 1996). In this '*invitation stage*', the potential player is attracted to the play design by sight, sound or smell senses from a distance. Next, the player explores opportunities for interaction and play in the '*exploration stage*', wanting to understand aspects such as rules and affordances. This stage leads to the actual play experience: the '*immersion stage*'. The fourth stage of participatory interaction, such as social networking and presence technologies, is outside the scope of our project. Our design research examines how to design for these different stages of play and how the playful experiences can be supported in each of these stages.

This paper describes an explorative study with a first design prototype, called FlowSteps, intended for children aged 7-8 years old. We address two research questions. We explore (1) how to design for the playful experiences of curiosity, exploration, challenge, fellowship and competition (2) for three different stages of play: invitation, exploration and immersion. The structure of this paper is as follows. First, we describe related work in play research. We continue with a description of our concept FlowSteps and how this relates to the playful experiences and stages of play. Thirdly, the set-up and methodology of our explorative study is discussed. We present the results of this study from the perspectives of game play, playful experiences and stages of play. We conclude this paper with a discussion.

2. RELATED WORK

Our research on intelligent play environments is closely related to various areas in play design research. In this section we discuss several designs and studies concerning open-ended play, intelligent playgrounds, playful persuasion and stages of play. #

In open-ended play, no (game)rules are predefined; instead, the meaning of the objects and interactions are defined while they are being used (for more information see Bekker et al. 2010). First design explorations included the ColorFlare (see Figure 1). The ColorFlare is a cylindrical object that reacts on rolling, shaking and pointing by changing the color of its light, flashing the light and transmitting the color of its light to another ColorFlare. It shows how multiple interaction possibilities can lead to diverse forms of play, but was not designed with specific playful experiences or three stages of play in mind. Another example of open-ended play design is jogo (see Figure 1), a round play surface that allows children to make music by playing with ping-pong balls representing sounds samples (Creighton 2010). It allows children to try out possible interactions with the balls and the surface. This resulted in children using the design in various ways: from simply triggering sounds to actually making musical patterns. These examples support the assumption that designing for open-ended play can lead to diverse forms of play.

Figure 1. Two examples of open-ended play designs: ColorFlare (Bekker et al. 2010) and jogo (Creighton 2010)

More specifically, in our research we focus on intelligent playgrounds, environments "with one or more interactive objects that use(s) advanced technology to react to the interaction with the children and actively encourage children to play" (Sturm et al. 2008). By adding interactivity to a playground, outdoor play can be enriched in an appealing way, making it a more attractive alternative to computer games and television. Examples are Water Games (Pares et al. 2005) and Ada Floor (Delbruck et al. 2007). These examples involve games and interactions that are pre-defined instead of open-ended. For instance, Water Games is a large installation which was part of the Universal Forum of Cultures Barcelona 2004. It consists of multiple water fountains that can be activated by forming a closed ring of people and spin around the fountain. People are obliged to communicate and work together, which transmits ideas such as respect towards cultural diversity.

In exploring how to persuade children to social and physical behavior in a playful way, we looked more closely at playful persuasion. Playful persuasion aims at changing people's attitudes and behaviors in a playful manner, by applying playful mechanisms in a design (Romero et al. 2010). In this way, people are seduced to change their opinions and actions while appealing to their intrinsic motivations. Playful persuasion is an alternative approach to using more traditional persuasive mechanisms as tunneling and reciprocation (Fogg 2003). In 2009, Volkswagen started an initiative called 'The Fun Theory' (The Fun Theory 2009). Their mission was to change people's behavior by making it fun to do. One example is the Bottle Bank Arcade Machine which aimed at making recycling glass more fun. People can gain points by putting glass in the blinking hole. This design was evaluated briefly. A lot more bottles were recycled with the arcade machine than with a regular bottle bank. Our project focuses on play with children, which differs from the projects of The Fun Theory. We are interested into which design elements can influence the playful experiences of the players. Our goal is to both persuade them to start playing, but also to continue playing.

When playing with an interactive design, players go through an experience of interaction which consists of three stages that we call invitation, exploration and immersion. To the best of our knowledge, no examples were reported in literature of tangible designs specifically developed for these three stages. Instead, we discuss two studies that mention play or interaction behavior that changes over time. Tieben et al. (2011) refer to the invitation and exploration stage when discussing encountering an interactive design. The stages are not explicitly named, but curiosity is presented as a process of encountering, exploring, discovering and adjusting. In a sense, this is a combination of the invitation and exploration stage. Another study that

provides some initial insights on differences in play behavior over time is a study on prolonged play with the ColorFlare (op 't Hof et al. 2010). Children were asked to play with the ColorFlares in three free play sessions over a period of three weeks. Social interaction was measured for all sessions. Results show that communication in the first sessions was mainly about the interaction possibilities (exploration stage) and the later sessions about the games (immersion stage). As a conclusion, the authors name two phases of play: children first explore the possibilities of the play objects, after which they start to create their own games and rules – but the ColorFlares were not developed with these phases in mind. In our project we will explore how to design for the three stages of play in relation to the playful experiences. This not only includes the actual experience of playing a game, but also the experience of being persuaded to start to play and the experience of investigating the interaction possibilities of the design.

3. DESIGN RESEARCH APPROACH

3.1 Process

We follow a research through design approach (Zimmerman et al. 2007): generating scientific knowledge on how to reach a preferred state by creating and evaluating prototypes in various iterations. Theoretical assumptions are derived that inspire a design which is used in an experiment to verify the assumptions. In our case, the notions of playful experiences and three stages of play inspired the design of FlowSteps and these intentions are explored in the user study presented in this paper. In this way, we want to develop an understanding of how design decisions influence the behavior of players. We followed a user-centered development process, consisting of observations at playgrounds to get a feel for how children play with the current equipment and involving colleagues and students within our faculty in brainstorms and early try-outs of our ideas and concepts.

To examine how to design for playful persuasion, we determined which of the twenty playful experiences (Korhonen et al. 2009) were applicable for the context of intelligent play environments. We selected five playful experiences for our initial design: curiosity, exploration, challenge, fellowship and competition. Other experiences may be supported as well, but are not the aim of this study. In an iterative process the five playful experiences were incorporated into the concept (see paragraph 4.1). The three stages of play were also taken into account, making sure that at least one playful experience was supported in each stage.

3.2 Design

As a first exploration in designing for physical and social play the FlowSteps concept has been developed. The following scenario explains the functionality of the FlowSteps concept:

Karen and her brother Tom are at their neighborhood's playground. Karen walks by the FlowSteps. She sees a random mat lighting up. She stands still, curious to find out what is happening. The mat next to her lights up and she quickly jumps on it. She jumps on another mat and the light follows her. But then her older brother Tom, who was watching Karen having fun, jumps on one of the mats before Karen can, and he steals her light. They start to play against each other, defending their own light and stealing the light of the other.

Figure 2. The FlowSteps prototype

FlowSteps consists of multiple, flexible mats that support play through interactivity. Players can create their own games with the interactivity and position of the mats. It attracts players when no-one is playing by randomly lighting up one of the mats (invitation stage). As soon as a player stands on an active mat, the system reacts by changing the lights. The player can now explore the interaction possibilities with the mats, alone or with others (exploration stage). They can start developing their own games by giving meaning to the output modalities (immersion stage). A prototype of FlowSteps (see Figure 2) has been developed, consisting of six interactive mats. Each of the mats contains a pressure sensor and six LEDs: three blue and three red. The mats are connected through wires to an Arduino that controls the sensors and actuators.

Children can decide themselves to play with the red or with the blue light. By giving meaning to the interaction opportunities, they can create their own game rules. As a support for this, two different behaviors were created for the lights. The red light supports guided, physically active play as players need to 'catch' the red light and are triggered to continue this action (keeping red 'alive') as automatically another mat with light up in red that they can catch next. The blue light gives the children more freedom and control as they can decide themselves which mat they want to turn blue after they have caught the blue light. Both lights can support collaborative and competitive play. A time interval was set, based on a pilot study, to increase the challenge of catching the lights.

4. STUDY

An explorative study was conducted to examine our concept on the aspects of playful experiences and three stages of play. In this paragraph, we describe the set-up of this study, the methodology used and the analysis.

4.1 Research Questions

In this study we address two research questions. We want to explore (1) how to design for playful experiences (2) in the three stages of play. We discuss the relationships between design elements, playful experiences and expected behavior. Besides these two questions, a verification of the concept is of importance as FlowSteps should elicit diverse forms of play.

The current design incorporates the playful experiences of curiosity, exploration, challenge, fellowship and competition. *Curiosity* is "a strong desire to know or learn something" (Oxford dictionaries 2012). It is no independent playful experience according to Korhonen et al. (2009), but we believe curiosity is such a strong experience that it can serve as a separate step towards exploration. It is mainly elicited by actively encouraging potential players to interact with the design. In the case of FlowSteps, the mats randomly light up to show the user that it is active and that they can interact with it. This triggers the player's curiosity: What is it and what can I do with it? *Exploration* concerns exploring or investigating a (virtual) world, affordance, puzzle or situation (Korhonen et al. 2009). Exploration is mainly supported in the FlowSteps by simple and diverse interaction possibilities supported by the two separate colors that and direct feedback by for instance lighting up a new mat when a players stands on an active mat. *Challenge* is the experience of having to develop and exercise skills in a challenging situation (Korhonen et al. 2009). The design provides challenges by including a time aspect: if a player does not step on a light fast enough, s/he will lose the light and will have to start over again. A second important aspect of challenge is the possibility for goal-setting, which is supported by consistent rules of interactions. As children play together with the FlowSteps, *Fellowship* and *Competition* are also relevant: players can play together and strengthen their bonds or they can play against each other and try to defeat another player or group of players (Korhonen et al. 2009). These aspects are supported by using multiple mats that are shared (instead of personal) objects that both players can use at the same time. Players can give hints to each other and play towards a mutual goal. Or they can try to reach the red light first or steal the blue light from the other player.

Although these experiences are presented here as separate experiences, many of them are actually related: they can enhance or reduce each other. For example, with strong competition the experience of challenge can become even stronger. Most of the playful experiences described above are expected to be mainly supported during one particular stage: curiosity in the invitation stage, exploration in the exploration stage, and challenge, fellowship and competition in the immersion stage.

4.2 Set-up, Methodology and Analysis

A qualitative, explorative study was carried out at a primary school in The Netherlands. Twenty children (ten pairs) aged 7-8 years old interacted with the design during a free play session. A familiar environment (an unused classroom at the school) was used. The teacher decided which children to pair-up, based on who were likely to play well together (both same-gender and mixed-gender). All sessions were carried out according to the same protocol. The session started with the test leader leaving the children alone with the design for about half a minute, in order to evaluate the *invitation stage*. After a short introduction the children were asked to

start *exploring* the design. After two minutes, the interaction was explained further and the children were asked to come up with a game. They played for two periods of seven minutes (with a short break in between). When children started talking to the test leader, she brought their attention back to the design and when they were distracted or became less active in their play, she asked them to come up with a new game.

The play sessions were analyzed using qualitative research methods (Strauss & Corbin 1990). During each session, video recordings were made. These recordings were analyzed by observing the videos and logging relevant events. During a first round of analysis, the videos were observed without any pre-determined observation scheme. The first author analyzed the videos for events as physical actions, utterances or social behavior. In this way, a first analysis of the data was made based on open coding (Strauss & Corbin 1990). In a second round, the first author observed the videos again, paying special attention to the playful experiences. Besides these recordings, we also asked the children about their experiences during the play session. The output of these interviews was combined with insights from the observations.

5. RESULTS

In this section, we will present the findings of our study, describing both the game play during the play sessions and the extent to which the playful experiences of curiosity, exploration, challenge, fellowship and competition elicited the expected behavior for the three stages of play.

5.1 Game Play

During the play sessions, the participants tried out various movements and used both their hands and feet. Although game play differed between participants, most of them were quite active in their game play. The flexible design (loose mats) supported actions as picking up, stacking, throwing or moving them and dividing the mats. Most games involved stepping on the mats, but not all games used the interactivity of the design, e.g. one pair used the mats as a sort of game controller. But the interactivity of the design led to diverse forms of game play and the children clearly responded to the lights. They also talked with each other about the lights: “I have red!” “Me too!”. Some pairs stopped playing with red and waited for blue to appear, in order to play with blue. Multiple participants talked to the lights, persuading the lights to come to the mat(s) they were standing nearby: “Here blue, come here!” Other players divided the colors: one player could only play with red, the other player only with blue.

Figure 3. Children playing with the FlowSteps. From left to right: a child pointing at the design; two competing children; children dividing their mats; another child inspecting one of the mats closely

Observations show that children created their own rules on top of the interaction rules of the design. This led to interplay between the conceptual model incorporated in the design and the mental model the children developed while playing with the design. Two layers arose: the formal rules and children’s own rules. In this second layer, the children could give meaning to (aspects of) the design. For example, children moved the mats closer and further away to reduce or increase the challenge or considered the blue light to be more special, as it was scarcer than the red light.

Overall, the FlowSteps supported diverse game play and forms of interaction. Children seemed to enjoy playing with the FlowSteps as they were laughing and expressing that it was fun. All children were engaged in various forms of social play. After the short break, the participants were eager to start playing again. At the end of the session, almost all children confirmed they would like to play again with the FlowSteps.

5.2 Stages of Play & Playful Experiences

This section describes how the five experiences of curiosity, exploration, challenge, fellowship and competition are supported by design elements in the three stages of invitation, exploration and immersion. Table 1 shows an overview of the stages and the playful experiences. For each stage in which a playful experience was present during the play sessions, the design elements that supported the playful experience is described in the corresponding box. Each stage will be discussed in more detail below.

Table 1. Overview of playful experiences in stages of play

	Invitation	**Exploration**	**Immersion**
Curiosity	Active design, Ambiguity	-	-
Exploration	-	Direct feedback, Flexibility mats	Interaction possibilities
Challenge	Ambiguity	Simple interaction	Difficulty, timing, goals, scores
Fellowship	Shared objects	Shared objects	Shared objects, Blue light
Competition	-	Flexibility mats	Shared objects, Red light

5.2.1 Invitation Stage

In the invitation stage we expected *Curiosity* to be present. The video data showed a variety of behaviors. Some participants waited patiently or smiled a bit uncomfortable at each other. Others looked around in the classroom, being distracted by other objects. A third kind of response focused on the design by pointing at it, talking about it, calling the colors that lit up ("Blue! Red!") or even stepping on it. The active aspect of the design supported curiosity as children already reacted on the lights before interacting with it. Next to that, curiosity was also supported by the unfamiliarity and the ambiguity of the design. The ambiguity of the design also played a role in supporting *Challenge* in this stage. Not knowing immediately what it does and how it works shaped a first challenge of getting to know the design. As a third experience, *Fellowship* was supported as the design consists of shared objects, 'forcing' the children to get to know the design together.

5.2.2 Exploration Stage

In the exploration stage, we expected *Exploration* to be supported. All children immediately started exploring the mats, by hitting or stepping on one of the mats. These actions were supported by direct feedback of the design: lights appearing or disappearing. Children also tried kicking the mats harder, faster or multiple times. The flexibility of the mats supported other forms of explorations as picking up a mat and looking at it closely, moving the mats to a different position and stacking the mats. A couple of children were really busy with trying to find out how the design worked exactly (looking closely at the mats, including the bottom and the wires) and claiming that they understood how it worked, explaining it out loud. In this stage, the experiences of challenge, fellowship and competition were also supported. *Challenge* was supported by simple interaction, which made the design easy to use but hard to master. Again, *Fellowship* is supported by the shared objects, as the children explored the mats together. *Competition* was supported by the flexibility of the mats, which allowed players to appropriate their own mat and not let the other player touch it.

5.2.3 Immersion Stage

We expected to see challenge, fellowship and competition in the immersion stage. *Challenge* was supported by aspects as difficulty in understanding the interaction, timing of the lights and ability to assign goals and keep scores. Many participants mentioned the difficulty of the games play that improved the fun of playing: "Now it is getting even more difficult. That's cool!". The difficulty of the interaction possibilities with the lights can be divided into three 'levels': the lowest level involves simply catching the light and waiting for another mat to light up; one level up is keeping red alive by jumping on the red lights only; and the highest level involves keeping the blue light alive by jumping on inactive mats. Some participants did not reach this highest level, but still had fun playing with the design on the lower levels. Concerning timing, a couple of participants mentioned that the lights were going (too) quick or that they had to run very fast in order to catch it, which they seemed to enjoy. One participant mentioned: "If the mat is too far away, you shouldn't go for it as it will be already gone." Most participants came up with multiple goals during their play sessions. They divided the colors or kept score for a short while, which could lead to a winner of the game. *Fellowship* was again supported by the shared objects, so that the children had to play with the design together. Some

participants clearly helped each other, by pointing at active mats or letting another player catch the light. The interaction rules of the blue light were an extra support for fellowship, as most players needed each other in order to keep the blue light alive. This was different for the red light, which clearly supported *Competition* in this stage. The participants used physical contact as pushing to prevent the other from reaching the light first. For this experience, the shared objects supported the players in playing against each other. *Exploration* was also visible in the immersion stage, supported by the diverse interaction possibilities of the lights. Children moved from playing a game with one of the lights to exploring the behavior of the (other) light and back.

Besides the playful experiences described above, the data also showed us experiences we did not expect beforehand. For instance, children imagined the floor to be water and the mats to be little islands they could stand on. This is a form of fantasy play, which is another playful experience according to Korhonen et al. (2009). Children were also involved in parallel play a lot; both players were playing with the mats, but actually playing their own game next to each other, without actively noticing or involving the other player.

6. CONCLUSION

We examined how a design of an open-ended play environment can support playful experiences in different stages of play. A first design called FlowSteps was developed and evaluated in a study with twenty children. In this study we explored how to design for three stages of play: invitation, exploration and immersion. For each stage, we determined relations between the abstract description of the (supported) playful experiences and the design decisions. The results show clear differences how to support the playful experiences in the stages of play. For example, not all experiences are suitable for all stages. Curiosity for instance is mainly suitable for the first stage of inviting potential players to start interacting with the design. Other experiences can be present in all stages, but the design elements that support them differ. Challenge for example is supported by ambiguity in the invitation stage, simple interaction in the exploration stage and difficulty, timing, goals and scores in the immersion stage. This has shown us that being aware of these three stages of play when designing for playful experiences is crucial as supporting these experiences can vary for the different stages of play. Some of the experiences become more important when players are in the immersion stage. For instance, fellowship is supported by the shared objects in all stages, but extra support is offered by the interaction rules of the blue light in the immersion stage as players needed each other to keep them alive.

Overall, we have gained insights from this study on how to design for playful experiences by incorporating specific design elements for the different stages of play. We expect the three stages to help other designers or design researchers in enriching their play designs. Extended research is needed to further ground the current results.

7. DISCUSSION

This paper describes a first study with the FlowSteps that was performed with twenty children aged 7-8 years old. This user sample showed quite some differences between the individual children. As our goal was to use an explorative test set-up, this was less of an issue. In future research, we are considering using a tool to describe the children, for instance Teele's Inventory of Multiple Intelligences (1992). The prototype used for the study was a wired prototype consisting of only six mats. The wires diminished the freedom in play, but were long enough to move them around and children did not react disappointed on this. The number of mats was appropriate for this study, but different play behavior can occur with more mats and children. In a next iteration, the design should be improved by making it wireless and by creating more separate objects.

Through this explorative study we gained insights on supporting playful experiences in design and a better understanding of the three stages of play. Compared to previous work as for instance the ColorFlare (Bekker et al. 2010) and jogo (Creighton 2010) with a focus on the general notion of play, we have aimed at the experience of interaction through the three stages of play which resulted in a better understanding of how play develops and how to support that. We created an overview illustrating our first results, relating playful experiences to the stages of play. In our current overview (see Table 1) not all cells are filled in. This is also not the aim of the overview; it is considered important to incorporate at least one playful experience for each stage in order to support the total play process. Our current overview is based on one case study. Therefore, it

is most definitely not a final version and it should not be used as such. Although the aim of this study was to explore how to *design* for playful experiences in different stages of play, our approach and the nuances between the three different stages might also be useful for *evaluating* play design.

This paper illustrates our first step in creating a ground for designing for playful experiences in three stages of play. Awareness of these three stages in the design process helps in shaping a better view on how to support playful experiences in open-ended play. We will continue to investigate further iterations of open-ended play designs in order to expand our knowledge.

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