Dropping in to Game Design: Iterations of a Skatepark Physics Game for a Children's Museum Exhibit

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Abstract: This poster paper describes how findings from playability tests of adult-child dyads changed our design approach for a design-and-play skatepark physics game. Played on a multitouch interactive tabletop, the game, which will be sited in a skatepark-themed children's museum exhibit, invites users to design their own skateparks using physics concepts, and then test out their designs. Less-structured 'sandbox' mechanics sometimes caused frustration, and interaction design issues could interrupt adult-child collaboration.

Overview

In this poster we present our iterative approach to creating a design-and-play skatepark game for a physics exhibit at a children's museum, and we focus in particular on how our design approach shifted after parent-child dyads test the game. Played on a 128cm wide multitouch interactive tabletop, the game invites users to design their own skateparks, explore physics concepts, and then test their designs by playing through them. We aim to create a game-based learning experience that helps: a) children develop interest in science-related design activities by seeing their relevance to the real-world practices; b) families engage in intergenerational learning and collaborative problem-solving. The larger in-development museum exhibit intends to help visitors ages five to eight, along with accompanying adults, make connections between physics, skateboarding, and design activities. This paper presents an initial design approach embodied in a game prototype, summarizes findings from playability tests with adult-child dyads, and explains our subsequent shift in design approach.

Initial design approach: Intergenerational tinkering in gameplay

Our overarching design goals centered on crafting a virtual space that would: a) invite users to engage in open-ended 'tinkering' with a skatepark environment; and b) foster collaborative play between generations of adult and child museum visitors. 'Tinkering' activities in museums are generally understood as creative exploration, modification and manipulation of materials or representations that are situated in an ill-defined problem space (Gutwill, Hido, & Sindorf, 2015). Exhibit-sited games that employ tabletop user interfaces can provide well-scaffolded tinkering experiences because they provide just-in-time feedback and visual cues for understanding a problem space, and support collaborative sense-making (Horn et al. 2012).

The first game prototype offered players the ability to design skateparks in a two-dimensional 'sandbox' space. Using an interactive panel along one edge of the screen, players could select skatepark elements like kickers, quarter pipes, and rails from a left-screen menu interface. They could choose to drag however many pieces from this menu into the skatepark, decide how to position said pieces, or delete them. Users could start the skater character wherever they liked, and adjust the mass of the skater using a slider bar. In doing so players had to make decisions about how skatepark elements were arranged at different heights and locations, and reason about how such arrangements might accomplish their endogenous design goals (see Figure 1). Our tentative conjecture was that interface buttons that were harder for children to reach might elicit parent involvement.

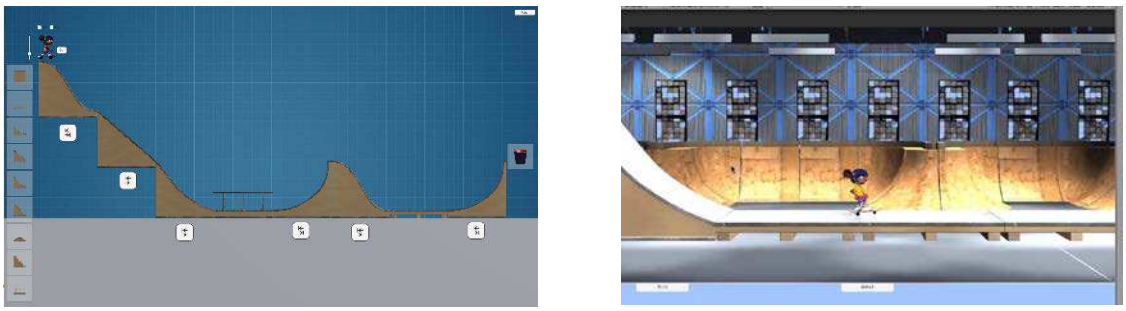

Figure 1. Design and play interfaces from the first game prototype.

Method: Playability testing and iterative agile development

This paper presents a design narrative from the projects' in-progress playability testing. Other empirical research on this project looks at the relationship between the design of the game and collaborative learning processes. The game development team has chosen to use the iterative framework of *agile development* for its processes, which emphasizes incremental and iterative organizational solutions to respond to users' engagement with early builds (Rajlich, 2006). As the exhibit is under-development, playability tests were conducted in a spare conference rom.

Playability test & redesign: Interaction, structure, and looking for 'learning'

While five out of six dyads reported that they enjoyed playing the game, we focus here on observations and feedback that resulted in changes in the game design. Three major areas for improvement were identified: a) players experienced frustration at trying to navigate interfaces, manage skatepark elements, and align skatepark elements; b) players were unsure how to initially position the skater-character and what goals they should have in designing the skatepark; and c) parents were uncertain about how they should help their children learn about physics. The interaction design of skatepark creation was a significant problem, as players spent most of their time trying to manage up to three dozen skatepark elements on the screen at once and making sure the fine boundaries of skatepark objects aligned so that the character did not collide with protruding edges. Children were frustrated at their inability to reach distant interface elements, and parents had to interrupt productive interactions with their child to help with reaching interface buttons or cleaning up skatepark elements. The full poster will present these findings in more detail.

We addressed these issues by: a) redesigning the interfaces and interactions involved in skatepark creation; b) giving the players optional exogenous goals in skatepark design and constraining where the skater could be positioned initially; and c) beginning to address the problem of parent support by displaying visual feedback about the skater's change in velocity during play mode (see Figure 2). We worked on smoothing the flow of interaction by limiting the number of virtual skatepark elements that could be on the screen, allowing players to change any given element into any other element, and implementing a snap-to-edge algorithm such that elements would automatically align if close enough together.

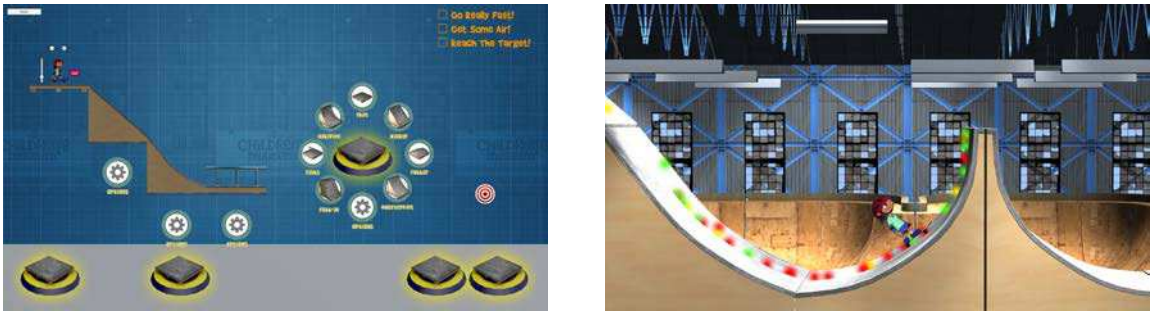

Figure 2. Design and play interfaces from the second prototype.

We have begun trying out implementation of simple optional goals (e.g. going fast, getting air, reaching a challenge) to help orient the players toward possible design challenges. Presently, development is examining ways to make the goals more meaningful, align progressively more-difficult challenges, and give players suggestive feedback on the design of their skatepark. We are also looking at design representations and signage, both in and out of the game, that suggest to adults how they might scaffold their child's engagement with design problems. If accepted, the poster will describe the results of these design approaches.

References

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