4. Using Connected Learning Design Principles to Further Co-Create a Critical Speech Therapy Game

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Abstract: Therapy can be costly, time consuming, repetitive, and difficult. Games have the power to teach transferable skills, can turn repetitive tasks into engaging mechanics, have been proven to be effective at delivering various forms of therapy, and can be deployed at large scales. Therapy games represent fertile ground for connected learning. In this work, we collaborate with 7 children with corrected cleft palate aged 2–10 and their parents during their yearly visit to UC Davis Medical center to co-create and evaluate *SpokeIt*, a speech therapy game. Each of these children comes from low socioeconomic statuses with limited access to speech therapy and would benefit from the amplified opportunities of new media in connected learning. Throughout the study, we ran multiple cascading participatory design sessions using design principles of connected learning, which culminated in the design of 2 new medium-fidelity prototypes presented in this paper.

Introduction

In 2012, nearly 8% of children aged 3–17 in the United States had a communication disorder, and younger children, boys, and non-Hispanic white children were more likely than other children to receive an intervention service for their disorder (National Center for Health Statistics, 2015). Correcting speech is an important issue because children with speech impairments have high risks of behavioral problems and increased symptoms of depression (Hunt, Burden, Hepper, Stevenson, & Johnston, 2007). They show more deficits in social and academic competencies, score higher for social problems (Feragen, Kvalem, Rumsey, & Borge, 2010), and are more likely to be teased in social settings (Hunt et al., 2007). These are serious consequences for a skill that can be improved (Aten, Caligiuri, & Holland, 1982; Johnson & Pring, 1990; Robertson & Thomson, 1984). Even those who undergo corrective surgery tend to display a delay in scholarship, have a lower income, marry later in life, and become independent from their parents significantly later (Sousa, Devare, & Ghanshani, 2009). After surgery, practice and support are the keys to improving speech (Cicerone et al., 2005). While speech-language pathologists (SLPs) employ many engaging games (Mashima & Doarn, 2008), progress in speech is often slow or lost at home because speech practice at home is usually hindered by a lack of intrinsic motivation that is due to the tedious and repetitive idiosyncratic nature of traditional speech therapy curriculums (Aten et al., 1982). Parents also experience significant difficulties in prompting their children to complete speech exercises at home, especially if they are very young (Miesenberger, Klaus, Zagler, & Karshmer, 2010).

Speech therapy games could help children practice at home and expedite their recovery (Rubin, 2017). Games have the potential to turn repetition, such as repeating words in speech therapy, into an element that is recognized as useful for progress in the game (Kaufman, 2010). Literature has shown that games are an effective educational intervention and medium to convey and support feelings of self-efficacy because of the immersive and pervasive virtual environment and that they have been shown to work effectively as educational interventions (Gee, 2005). Games have demonstrated the ability to teach while providing a motivating and interactive environment (Virvou, Katsionis, & Manos, 2005), are effective with children (Rosas et al., 2003), and can be as effective as face-to-face instruction (Randel, Morris, Wetzel, & Whitehill, 1992). A variety of serious games for health have been documented to be useful for their target populations, and they are wide ranging in their platforms, health outcomes, and target populations, from an exergame to help blind children with balance (Morelli, Lieberman, Foley, & Folmer, 2014) to embodied persuasive games for adults in wheelchairs (Gerling, Hicks, Kalyn, Evans, & Linehan, 2016) to mobile games for motivating tobacco-free life in early adolescence (Parisod et al., 2017).

Background

SpokeIt is a speech therapy game equipped with a critical speech-recognition system capable of "hearing" many common speech errors. SpokeIt contains numerous minigames that target specific types of speech therapy, such as rhythm and articulation, that fit within an overarching narrative. *SpokeIt*'s narrative, mechanics, and characters were iteratively co-designed and presented in our previous works (J. Duval, 2017; J. S. Duval, Márquez Segura, & Kurniawan, 2018).

Method

We visited our collaborators at UC Davis Medical Center, where children with corrected cleft are assessed by different medical experts, including speech pathologists, behavioral therapists, plastic surgeons, sleep therapists, dentists, and so forth. We were invited to take part in a "clinical day," in which patients are assigned to a room while a variety of doctors rotate in and out to see each patient. Per request of the speech language pathologist and to minimize interference with the doctors' rotations, we designed co-creation sessions that lasted 10 minutes and which would be conducted during "gaps" when no medical professionals were present in the patient's assigned room. Seven children participated in our study; their ages ranged from 2 years, 7 months to 10 years, 9 months (*M* = 6 years, 1 month, *SD* = 3 years, 6 months). They were accompanied by their parent(s), who observed them play and were also interviewed. We also interviewed two speech language pathologists. In all, we collected data on seven children, seven parents, and two speech language pathologists.

Connected Learning Design Principles for Meaningful Co-Creation

Figure 1. Design probes used for cascading participatory design sessions.

Everything Is Interconnected

In order to come up with play scenarios, children were provided with tangible co-design probes, toys, and props (see Figure 1). The tangible representations of our characters connected the play session to the *SpokeIt* universe. The animal flash cards and word flash cards were chosen because they are rated as developmentally appropriate words for ages 3 and higher. The letter and number magnets were useful random character or number generators. The stickers were a gift to the children for participating. At the beginning of the session, we played *SpokeIt*'s cinematic on a laptop to remind participants of the story and to help them connect the virtual and tangible characters. Next, children were presented with the rest of the tangible co-design probes to create and play game scenarios. Between sessions, we created medium-fidelity prototypes of these play scenarios in Adobe XD. We then had the following participants play and critique the Adobe XD prototypes so that each design was tested and iterated with subsequent participants, hence cascading participatory design sessions.

Learning Happens by Doing

To inspire them, they were asked first to play either a play scenario we had prepared or one that a previous child had proposed. Children were encouraged to iterate these scenarios, changing the rules, objects used, and so forth, and to play the new scenario. For example, if a game required them to repeat a word X number of times, where X is a number magnet pulled from a container, we asked that they physically draw a number and repeat the word that many times.

Challenge Is Constant

In the latter cascading co-creation sessions, the children played scenarios that had already been mocked up in Adobe XD. Facilitators presented the iPad with the prototype running and read the written instructions out loud to the children. Using Wizard of Oz techniques (Dow et al., 2005; Fraser & Gilbert, 1991), facilitators took the role of the speech-recognition system and the narrator. They would clarify instructions, give helpful hints, and provide feedback when necessary as the game would do when it is finished. We took note of when they were engaged, which design elements the child seemed to enjoy the most, and when the child needed more support.

Anyone Can Participate

After they played the previously made designs, we invited children to come up with another play scenario using the tangible probes. The facilitator helped the children polish it with questions such as: What happens next? How do they do that? What do they need to say to help? The facilitator reminded players that all of the challenges should require speech. Once the play scenario was concluded, the child played it once or twice with the help of the facilitators. Last, the children were asked general questions about the play scenario, such as: What do you like the most about this game? Why? What do you like the least? Would you like playing this game at home? They were also asked which game of those they had played they liked the most. At the end of the session, the child chose a game character sticker to take home as a souvenir.

Designs

Figure 2. Adobe XD medium-fidelity prototype of farm-to-table minigame rapidly developed during gaps.

The first design (see Figure 2) is a farm-to-table minigame in which players cultivate the crops needed to make a salad. In this minigame, players pick the various fruits and vegetables by saying the name of the vegetable. If the salad requires five tomatoes, they would say *tomato* five times. During the Wizard of Oz Adobe XD playtests, we gained valuable knowledge about how we naturally support children and ideas on how this should be incorporated into the final product: It helps to repeat the same directions but worded in different ways. Different children can complete the same challenge in various directions. Silence and numerous incorrect attempts indicate confusion. We found the magic number to be that three seconds of silence or three incorrect attempts in a row indicate the child might need support. If there is a list of items required, it helps to provide example solutions. The game should ask the children if they need help when they might be struggling. Sometimes they need more time to complete the task or a few more tries. We also found that children enjoy silly euphonious words such as *pickle*, which may be more challenging to guess but are more rewarding because they are fun to say.

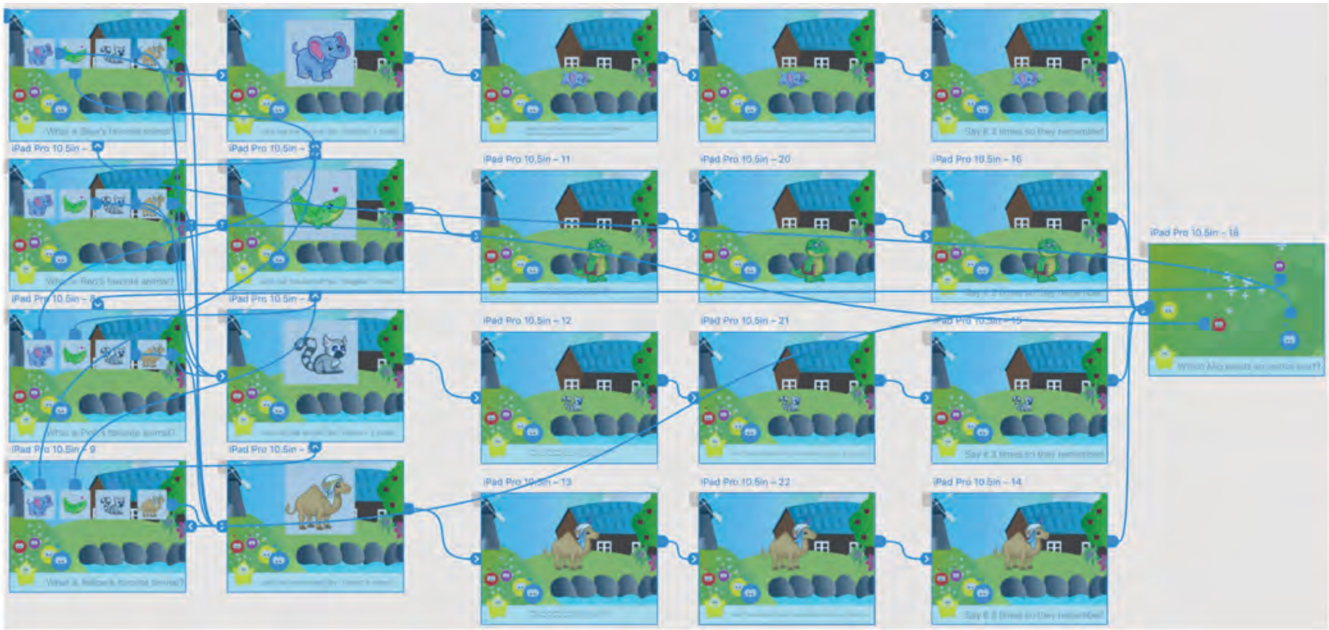

Figure 3. Adobe XD medium-fidelity prototype of farm animals minigame rapidly developed during gaps.

The second design (see Figure 3) started as a predesigned scenario to spur creativity. However, the children enjoyed playing it and iterating on it, so we decided to mock it up in Adobe XD on the scene. The characters were at a farm with no animals. To bring an animal to the farm, the child needed to say the animal's name and the sound that the animal makes. To give the animal a name, the child needed to say a name that started with the same sound as the type of animal. At this point, the facilitator asked the child to pick a number card out of a box randomly. "[X] times! You need to say their name [X] times, so they remember it." When the child calls the [animal] [X] times, that animal's card is turned over. The same process is repeated with the three other animals.

Discussion

In this paper, we present a novel co-design method that emerged out of the constraints and possibilities of our testing environment: a tight fast-paced cascading co-design protocol featuring play, tangibles, on-scene medium-fidelity prototyping, Wizard of Oz techniques, and continued iteration of designs using the design principles of connected learning.

Learning Happens by Doing

We found two aspects essential: First, a warm-up scenario is helpful so that children understand what they need to create, and second, having tangible play props. The character props allowed children to immerse themselves in the universe and come up with interesting play scenarios. Children liked these tangible characters (even wanted to keep them), held onto them, played with them, and felt comfortable using them to make new games.

Challenge Is Constant

The props directly influenced emerging games, which is why choosing appropriate props was extremely important. We used wooden magnets to act as random letters and number generators, age-appropriate flash cards to prompt words that need to be spoken, and tangible felted characters crafted to look like the characters in the game. The props directly influence resulting designs, so if the facilitators are not careful with these choices, the emerging play may be constrained by rules that do not fit goals. It can be challenging to redirect focus and play to the goals of the session. Our probes, especially the flash cards, helped keep play constrained to using speech. Because children had already played the game, they understood the constraints of the *SpokeIt* universe. It helps to define the play space clearly.

Anyone Can Participate

Co-creating a game—even if it is a sketch of a play scenario—is challenging, and even more so if the co-creators do not have a background in game design and are children(!). However, children are experts in make-believe, and crafting a magic circle comes naturally to them. The challenge is crafting "the right circle," one that can help them in their therapy.

Everything Is Interconnected

We used breaks between sessions to create on-scene medium-fidelity interactive prototypes based on games children made with our tangible probes. This meant valuable design knowledge was not lost to time because it was made immediately after sessions. Each design could be iterated multiple times in the day, with multiple children, in a medium-fidelity environment (Adobe XD). Children evaluated other children's designs, which gave insights into which features were essential to multiple children versus just the child who made the game.

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