This article presents a model for incorporating children as partners in the process of designing new technologies.

3

Children as codesigners of new technologies: Valuing the imagination to transform what is possible

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I ONCE MET AN EIGHT-YEAR-OLD BOY who lived in inner-city Chicago. He had never visited a public library, had never ventured into a museum, and had never heard his mother read to him. He taught himself to read looking through *People* magazine in the beauty shop where his mother cut hair. When I asked this eight-year-old, "If you could change the library, how would you do it?" he answered, "Oh, that's easy. I would change the floor into grass. I've always wanted to read a book sitting in the grass, but it's not safe."

This was one way my team and I began designing a new digital library for children. Having a conversation about the future of libraries and computers was a bridge to having an honest discussion about what was important in a child's world. This boy's dream of sitting in the grass and reading was a powerful reminder that where we use our information resources is as important as how we find them. So often as we make new digital libraries for children, the focus is on the search experience: How do children find what they need? This searching experience should not be ignored since children look for their digital books or online information in ways

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that are very different from the way adults do this. But just as important is the experience children have with the things they find. Do they read, hear, or explore digital artifacts in ways that are comfortable, age appropriate, and engaging?

Over three years in four countries, our team talked with children, ages seven to nine, about the future of libraries and computers.[1] We interviewed them and asked them to interview their own classmates. They drew pictures of their libraries of the future and read and reviewed books in our digital library. What emerged frequently from our work in the United States, Honduras, Germany, and New Zealand was, to our surprise, the importance of places to read. In Germany, the children told us how much they disliked the hard concrete floors in their school library. In New Zealand, the children could not say enough about how much they liked, of all places, the school library's steps. It was their favorite place to read. In Honduras, the school's library was so crowded with stacks of books that the children talked about wanting more places to read. And of course in the United States, we heard from inner-city Chicago about the need for grass and more comfortable places to curl up with a book. What these children taught us about informal reading spaces is reflected in the International Children's Digital Library (www.childrenslibrary.org), a research project we began in 2002 at the University of Maryland and is now a nonprofit organization. It is a digital library where children can search in multiple ways and can read their chosen books using various digital book readers.[2] Although these book readers are not grass, they do offer different options for exploring virtually.

Making new technologies

Sherry Turkle, a social scientist who has published seminal books and papers on people's relationships with technologies, has pointed out that clinicians and social scientists have always used toys, clay, and drawings to work through children's concerns or understand the impact of something or someone.[3] Only recently have these

same artifacts been used to make better new technologies for children. These artifacts have been a crucial part of how children have changed what is possible for new technologies.

Since 1999, children have been my partners in codesigning new technologies for children at the University of Maryland's Human-Computer Interaction Lab. We have explored making new storytelling worlds, traveled to new outdoor places with mobile technologies, and taken new digital library journeys.[4] We continue today, twice a week, to work with children, ages seven to eleven, who come to our lab and join researchers from computer science, education, psychology, art, and robotics. Over the summer, the team meets for two intensive weeks, eight hours a day, to continue our research. Children have worked with us as long as five years and as short as one year. Together we have become what I now call an intergenerational design team pursuing projects together, writing papers, and creating new technologies.

Over the years, I have found that the most important goal of any partnership between adults and children is idea elaboration. The children I have had the opportunity to work with have not been my "sample" or "subject pool" but partners in understanding their world. My goal has been for our team of adults and children to elaborate on each other's ideas and to make sense of and refine what we know. This is when one team member (adult or child) shares an idea with the team. From this idea, a new thought or direction may be inspired by another adult or child. When these ideas build on each other to create new ideas, ultimately it may be difficult to remember whose ideas they were originally. What matters is that both adults and children share in the process together. It can be said that this elaboration process is the hallmark of any good design team with or without children. However, what makes this so important to partnerships with children is that idea elaboration is so difficult to have with young people. What is more common is that adults conceive of ideas and either teach them to children or ask for feedback. The notion of elaborating on each other's ideas is more difficult and therefore colors all that we do in our technology design partnerships.

Cooperative inquiry

To support the best circumstances for idea elaboration with children, our team has changed the way we set expectations, brainstorm, and reflect as a group. We have come to call this cooperative inquiry.[5] It is a process that enables adults and children to share their ideas yet minimize differences in age and communication styles. Cooperative inquiry is grounded in the human-computer interaction (HCI) research and theories of cooperative design, participatory design, contextual inquiry, and activity theory.[6] Either by direct partnering (codesign) or through observation, each of these research processes suggests paths for designing new technologies by deeply understanding the needs of users. What cooperative inquiry brings to the HCI research is a set of methods specifically created for working with teams of children and adults.[7] While teams may use all of these codesign methods at some point in the technology design process, some teams have found it better to use only a subset. What follows is a summary of the most commonly used methods by our team.

Low-tech prototyping

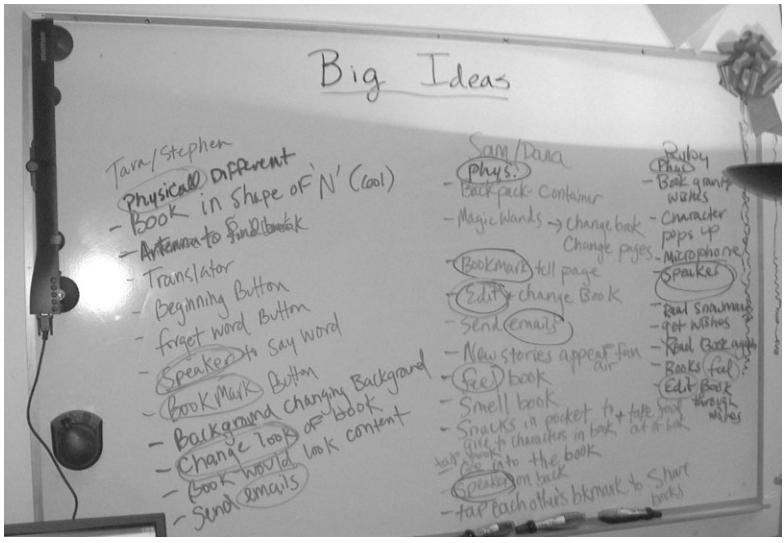
"Bags of Stuff," as it is called by the children on the team, or "low-tech prototyping," as it is officially named, is a prototyping technique in which children and adults use bags filled with art supplies such as glue, clay, string, markers, socks, and scissors to create low-tech prototypes of technology (Figure 3.1).[8] This is based on one of the oldest cooperative design methods used in Scandinavian countries.[9] While our team sits on the floor to use this method with children, which differs from the original Scandinavian method, we have found that this can strongly support bringing children into the design process. It can be a bridge for adults and children to become comfortable with each other as design partners. These are also materials that children have had experience with, so it makes the design process something more familiar to them.

Figure 3.1. Low-tech prototyping

After the low-tech prototypes are created by groups of two to three children and two to three adults working together, each group presents its ideas to the whole team. One adult team member is designated to take notes on the whiteboard during these presentations. We call these notes the "big ideas." As each team presents, the note taker writes down the ideas that are surprising, most repeated among groups, or receive the most reaction from the whole team (Figure 3.2). After the presentations, the team discusses these ideas and decides which ideas to pursue for a new round of low-tech prototyping or for further technology development.

There is value in tailoring the art supplies in the bag to prototype to specific projects. For example, with technologies that support music education, our team now includes many art supplies that make noise, such as small bells, sandpaper, and sticks. For mobile technologies with small screens, the bags can include such

Figure 3.2. Big ideas from presenting ideas

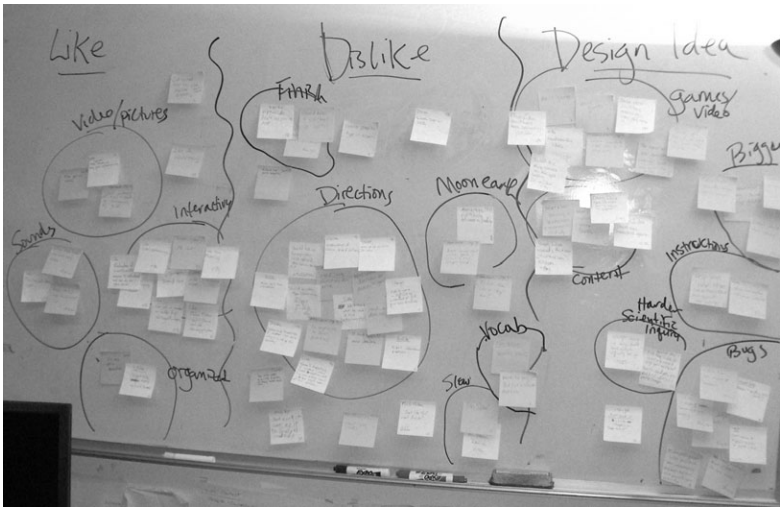


smaller items as sticky notes, hands-sized cardboard boxes, and stickers.

Sticky note frequency analysis

This cooperative inquiry method begins with each team member, adults and children, using a technology product or prototype. As they are working, all partners write down on sticky notes what they *like* or *dislike* about the current technology and any suggested design ideas. Each like, dislike, or design idea is written on a separate sticky note. As the notes are written, they are gathered and given to an adult, who places them on a large wall space, often a dry erase board or piece of large paper taped to the wall (Figure 3.3). The researcher leading the session groups the notes into categories. For example, many partners might like where the buttons are placed, or possibly lots of partners dislike the audio used; therefore, these notes are grouped together. The outcome is an informal frequency analysis that shows possible trends for informing directions for the next iteration of a technology.

Figure 3.3. Sticky note frequency analysis



Numerous researchers around the world have codesigned with children in varying ways to best meet their needs. Some use an overall scaled-down model of cooperative inquiry.[10] Some adapt it to a context other than a university lab, such as a museum, school, or field trips.[11]

My team and I continue to refine our cooperative inquiry methods and add new ways to bring children and adults together to envision the future of technology and learning. We know much is still to be done in supporting teams that work together at a distance.[12] In addition, with new mobile technologies to explore, new methods are needed that leverage the physical context and mobile activity of the child.[13] My hope is that someday these methods may lead to building a digital library that can let eight-year-old boys read in the grass on the floor of the library. My hope is these methods can lead us from imagination to transformation of new technologies for our children's future.

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