Working with Young Children as TECHNOLOGY DESIGN PARTNERS

A case study illustrates how even young children can contribute to the technology design process.

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How children's technology is developed, and who is involved in the process, can vary greatly. While there are many roles children can play in the design of new technology, at the University of Maryland we have focused on partnering with children ages 7–11. We have found these intergenerational partnerships can lead to unexpected technology innovations, as well as establishing design methods for working with children. Influenced by the cooperative design practices of the Scandinavian countries, and participatory design and contextual inquiry in the U.S., we have developed design methods for working with children called *Cooperative Inquiry* [3, 4].

The techniques of Cooperative Inquiry enable children and adults to work together to create innovative technology for children, and grew out of work with children ages 7–11 who meet in a lab twice a week after school and two weeks over the summer [3]. There are many techniques that can be used by a team developing technology through Cooperative Inquiry. One such method is a modified form of participatory design that involves sketching ideas with art supplies such as paper, cardboard, and glue to create low-tech prototypes during the brainstorming process [3, 4]. Another technique enables both children and adults to do observational research; all members of a design team (both children and adults) observe other children (not involved in the design process) using technology and capture activity patterns through an adapted form of contextual inquiry. Often, these observations are written on sticky notes, with children drawing their thoughts in pictures and adults writing their ideas with words [3, 4].

Figure 1. A small group idea for a Center of the Future: Storytelling Legos.

Over the past six years, Cooperative Inquiry has been extended and refined through a variety of projects conducted by ourselves and other researchers in Europe, Canada, and the U.S. [2, 5, 7, 9–12]. We have found that Cooperative Inquiry can work for diverse age groups such as 4–6 year olds [6] and 10–13 year olds [8], but that modifications are needed due to children's varying cognitive and social abilities [6, 8].

The mixing ideas technique, a framework for merging individual ideas in design collaboration, was developed through research concerning the Classroom of the Future. This five-year project, funded by the National Science Foundation (NSF), is focused on developing tangible, ubiquitous technologies for the preschool classroom [6]. Over the years, we have found that our youngest design partners (ages 4–6) are challenged by truly collaborating and elaborating on one another's ideas. Children can become visibly upset, withdraw from the design experience, or disrupt design activities if they feel they are not being listened to, or the team is modifying their idea. Children at this age can have a difficult time "letting go" of their own personal idea, yet their ideas contribute to the design process.

Mixing Ideas

Here, we describe a case study of how the mixing ideas technique can work with young design partners. Our work took place with 11 ethnically diverse children, ages 5–6. There were five boys and six girls who worked with five adults over a four-week period, in hour-long sessions held twice a week. Our research focused on developing new technologies for center time: an experience in the U.S. preschool classroom where young children are able to choose what to explore, play with, and learn. Typical centers may include building with blocks, playing computer games, reading books, and so on. Our central question to our young design partners was "How would you change the centers in your classroom if you could?"

Stage One: Each child generates ideas. We began our research by having each child observe their peers working at centers. During this stage, each child worked one-on-one with an adult. The children left their classrooms, and were brought into an observation booth in groups of two or three children. The children observed their classmates and drew what they saw in their research journals. The adults annotated the journal drawings with the children's words. Examples from the children's journals at this stage included such observations as "Alan and Peter are playing Candyland."[1] After the children drew what they saw, we asked them to draw ways to make these centers "better." The children suggested such ideas as "I want to be able to dress up at dramatic play. The clothes will walk by themselves and make noises when you push on a button ('woof')."

Stage Two: Initial mixing of ideas. After generating individual ideas we then began mixing them. At this stage, two or three children met with the five adults on the team, forming four groups. We began each session by having children explain their personal ideas and show their journal drawings. We then explained why we needed to mix ideas by using the analogy of baking cookies. Each ingredient by itself may not taste very good, but once all of the ingredients are combined, you get a tasty treat that is better

[1]Children's names have been changed to protect their privacy.

than each individual ingredient. We asked the children to close their eyes and put all of their ideas into a "mixing bowl" and stir them up to see what came out. The children and adults then began talking about possible ways to mix ideas. Once the group had an initial consensus, they created a name for the center and drew their ideas on a piece of table-sized paper. The results of these four groups were: Magic Funhouse, Magic Holiday Game, Storytelling Legos, and Zoo Center (as illustrated in Figure 1).

Figure 2. The cut up and remixed big idea.

At this point, it was our intention to jump directly to mixing the ideas of all four centers. However, in looking at how different the ideas were from each group and that the children still needed a great deal of structure in order to collaborate, we decided to add another step. Therefore, the four groups were grouped into two groups and The Magic Holiday Game and the Zoo Center combined to make Animal Holiday Games and the Storytelling Legos plus the Magic Funhouse combined to make Storytelling Funhouse.

Figure 3. The final big idea: Story Game Fun House.

Stage Three: Mixing the big idea. After these intermediate steps, it was time to mix the big idea. Before we had the 11 children meet together, the adults discussed possible ways in which the two ideas could become one, which offered us possible roadmaps in preparation, for our final mixing session. In preparation, we cut up the ideas from the previous stage into little pictures. During this last mixing session, the children rearranged the cutouts and put them together with tape as a way to begin thinking of how their ideas could fit together (see Figure 2). Then we used a large piece of paper and drew the big, final idea called the Story Game Fun House (see Figure 3)—an outdoor structure with many connected rooms.

Many of the more specific ideas from earlier stages in mixing ideas may appear to be lost in the final big idea. Although an individual idea may not be immediately apparent in the final concept, the mixing and elaboration process sparks imagination and innovation and each child and adult can feel they influenced the final outcome.

In our research, it is always our intent to push the frontiers of both the methodology used in creating technology for young children and the technology itself. To this end, we are currently developing technology that reflects concepts that emerged from the mixing ideas process. For example, children often visited other team members' creations leading to collaborative play, connecting ideas, and collaborative construction of new ideas. Additionally, the children were interested in outdoor environments. By combining these observations, we are exploring ideas involving collaborative environments that can support connectedness between young children in outdoor settings. We are currently developing technology to enable children to play and learn in outdoor environments while sharing information with one another.

What Children Thought of Mixing Ideas

We concluded the mixing ideas process by asking the children what they liked the best and what they felt was the "hardest" part of being a design partner. The children drew their thoughts in their journals and had an adult annotate their drawings. The most frequent answers included:

Likes: Drawing, mixing ideas, and observing. The aspect that emerged most frequently was the children liked drawing. Since most children at this age are not yet able to fully express their ideas clearly in writing, drawing gives them a way to do so. Allowing an adult to annotate their drawings enables more complete expression of their ideas. Another aspect the children liked was simply mixing ideas. One child mentioned combining ideas as his favorite part, while another mentioned his work on a center that grew out of mixing ideas as his favorite. Two children also mentioned they liked observing their classmates in classroom centers.

Hardest: Individual idea generation, physically

mixing ideas, and nothing. When children spoke of drawing as the most difficult part of mixing ideas, they referred to individually sketching ideas in their journals. Upon further discussion with them, we believe they were not necessarily referring to the act of drawing, but the individual idea-generation process before drawing. Some children also identified mixing ideas as the most difficult part of the process. One child found it difficult to tape ideas together; another had a difficult time drawing in the middle of the large paper. We have begun refining our methods to make the physical act of mixing ideas easier for young children. Finally, some children were at a loss for what the most difficult thing was about mixing ideas. These children seemed genuinely perplexed that any part of the process could be perceived as difficult.

Lessons Learned

Through the process of mixing ideas, we learned that young children need more structure to collaborate during the brainstorming process. By encouraging idea generation in smaller steps, and establishing parameters for collaboration with others, these young children were less frustrated and more productive in the brainstorming process. However, the challenge of this process is the amount of time it takes to get to the "big idea." This is not necessarily a process that can be navigated quickly.

On the other hand, this process has taught us the importance of valuing teammates' ideas. Past participatory design research confirms that to be successful, the participants must believe their ideas are important [1]. By beginning the mixing ideas process with time for individual brainstorming and sharing personal ideas, children feel they have been heard when it is time to mix ideas. In addition, one-on-one work between adults and children can ensure the children's ideas are communicated and well documented. The method of children's drawing with adult annotation can also help with young children who may have challenges expressing their ideas with words. Using some physical mixing of ideas, such as cutting and taping, helped to alleviate any possible tiring the children may have experienced from continually drawing.

Finally, as with all Cooperative Inquiry techniques, adults must remember their ideas are as valuable as the children's. Adults must learn when working with young children, with as much tact as possible, to gently elaborate ideas.

Conclusion

The case study presented here offers a roadmap for others to try with their own research teams. We believe that mixing ideas can be a powerful part of Cooperative Inquiry with young children. The process of mixing ideas with these younger children enhanced the effectiveness of other Cooperative Inquiry techniques designed for use with older children. Through technology implementation and further empirical study we expect to better understand the benefits of mixing ideas with young children. C

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