

Mixing Ideas: A New Technique for Working with Young Children as Design Partners

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ABSTRACT

This paper sets forth a new technique for working with young children as design partners. *Mixing ideas* is presented as an additional Cooperative Inquiry design technique used to foster effective collaboration with young children (ages 4-6). The method emerged from our work with children on the *Classroom of the Future* project at the University of Maryland. A case study of this work is presented along with the implications of this method for future research.

Keywords

Children, Cooperative Inquiry, design methods, participatory design

INTRODUCTION

New technologies for children continually emerge. From technology-enhanced toys such as Actimates Barney [25], to toilets that flush with the help of sensors [7], technology is becoming ubiquitous in children's lives. How this technology is developed, and who is involved in the process can vary greatly. Often, children are not consulted until the end of the design process, if at all. While there are many roles that children may play in the design of new technology (e.g., users, testers, informants, design partners [6]), we have found in our work that children can and should be design partners, an integral part of developing new technology as equal stakeholders throughout the design process [5, 6].

To this end, researchers at the University of Maryland pioneered the design process of *Cooperative Inquiry* [5, 6]. The techniques of Cooperative Inquiry enable children and adults to work together to create innovative technology for children. These methods include ideas adapted from cooperative design, participatory design, and contextual inquiry, but are tailored to meet the unique challenges of working with children [5].

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IDC 2004, June 1-3, 2004, College Park, Maryland, USA

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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 [5, 6]. Another Cooperative Inquiry technique was created to enable both children and adults to do observational research. Using this technique, 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 [5, 6].

Cooperative Inquiry 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 [5]. Over the past six years these design methods have continued to be used, extended, and refined on a variety of projects and in a variety of settings by researchers in Europe, Canada, and the US [2, 8, 11, 12, 14, 22, 23, 26, 27].

In recent years, we have begun to adapt the methods of Cooperative Inquiry to be used with other age groups. This includes older children who are 10-13 years old [15], and younger children who are 4-6 years old [10]. We have found that these methods work for diverse age groups, but that modification may need to be made for better partnerships with children of varying cognitive and social abilities [10, 15].

We are continuing to develop new Cooperative Inquiry techniques that are specifically suited to these different age groups. Thanks to ongoing partnerships with the University of Baltimore for the older children and the University of Maryland's Center for Young Children (CYC) for the younger children, we are able to continually refine these techniques. The *mixing ideas* technique described here was developed through our work with young children on one of our lab's current research projects described in the section that follows. The mixing ideas

technique is a framework for merging individual ideas into bigger, collaborative ideas.

CLASSROOM OF THE FUTURE

The Classroom of the Future research is a five-year, National Science Foundation (NSF) funded project. Through work on this project, we are discovering ways in which young children can aid in the design of and benefit from technology. The goals of this project include: understanding the unique needs of young children (ages 3-6) in learning environments; developing new technologies in partnership with children and teachers; and understanding the impact these technologies can have on young children and their early childhood environments. We are currently in the third year of this five-year project. We have focused our work with children at the Center for Young Children (CYC), a laboratory school educating children ages three to six on the campus of the University of Maryland. To date, we have had successful partnership experiences with 3 classrooms of children at the CYC using a modified form Cooperative Inquiry [10]. These experiences have led us to continue to modify the techniques of Cooperative Inquiry. Other researchers have reported in their own work that preschool children can demonstrate an understanding of what it means to be researchers [18].

In addition to advancing new technology design techniques, we continue to develop new technology for the Classroom of the Future. This technology is developed using Cooperative Inquiry. These technologies have included a *Magic Wall* [see Figure 1] that enables two children to collaboratively draw on a large vertical screen [10] and *StoryRooms*, [see Figure 2] an interactive physical storytelling environment in which children use technologically enhanced physical icons along with non-technological props to create, tell, and retell stories throughout an entire room [19, 20].



Figure 1: Children drawing on the *Magic Wall*, a technology created with our youngest design partners



Figure 2: Technological icons and non-technological props used in *StoryRooms*

CHALLENGES OF WORKING WITH YOUNG CHILDREN

Whenever working with children, there are challenges, and this is no different in Cooperative Inquiry [6]. As we take these design methods to different age groups, we find that the challenges differ as the ages of the children differ [10, 15]. This is not surprising given the quick rate at which young children develop cognitively, emotionally, and socially [4]. It is logical that techniques that work for a 13-year-old would not work, or at least need to be modified in order to work, with a 4-year-old.

As we work with our youngest design partners (ages 4-6) on the Classroom of the Future project, one challenge that stands out is the ability for children of this age to truly collaborate by elaborating on one another's ideas. The concept of building upon each other's ideas in an elaborative brainstorming process appears difficult for children of this age to understand and accomplish. They can have a difficult time "letting go" of their own personal idea to combine it with another person's to generate a completely new idea. According to Piaget's stage theory of development, children at the preoperational stage of development, ages approximately 2-6, are still egocentric [16]. This may help to explain why collaboration is a bigger challenge for our design partners at the CYC (ages 4-6), than for our KidsTeam design partners in the lab (ages 7-11) who have already progressed to Piaget's next developmental stage. Egocentrism in younger children may lead to difficulties in understanding that each individual's ideas can be put together to form one "big idea," and that in doing this, no one idea is necessarily lost, but that all ideas are incorporated together.

Over the years in our work with this age group, we have had children become visibly upset if their idea was not "chosen". We have had children not want to work in a team because they were concerned that their idea was not being used. We have also had children not speak or contribute because they felt their ideas were not being "listened to". In all of these cases, we found that given a bit more structuring of the design experience, children were

able to contribute successfully to the team brainstorming experience [10]. Ways in which to implement additional structure in the process have included increasing adult facilitation and more small-group activities as opposed to whole group work [10]. Out of these challenges, a new technique emerged as a part of our Cooperative Inquiry with young children: *mixing ideas*.

MIXING IDEAS - A CASE STUDY

The mixing ideas technique is designed to support young children in successfully collaborating during a brainstorming design process. With this in mind, we present a case study of how the mixing ideas technique can work with young design partners. In the Fall of 2003, we began work with our newest design partners at the CYC. They were 11 ethnically diverse children, all of whom were age 5 at the beginning of the process. There were 5 boys and 6 girls. The process described here took approximately one month, with hour-long sessions held twice a week. Due to periodic illness and other class activities, and the fact that most of the activities were done in small groups, all of the children were not involved in every design session.

Our goal was both to innovate new technology and to enable young children to collaborate successfully in the design process. Our technology design work focused on a critical part of an early-childhood educational experience: *center time*. During center time, sometimes called learning centers [9] or work time [13], children are able to choose different centers or classroom areas at which to explore, play, and learn. Typical centers may include: building with blocks, dramatic play (sometimes referred to as "dress-up" or "housekeeping"), computer time, book-reading area, etc. Our overarching question to our child design partners became: "How would you change the centers in your classroom if you could?" We used cooperative inquiry methods including the new process of *mixing ideas* to come up with answers for this question. The next sections present the process of mixing ideas as it occurred in three stages, from individual generation of ideas, to small group mixing of ideas, to the final mixing to create one team idea.

Stage one: Each individual child generates ideas

In order to enable each child to contribute to the design process, we began by having each individual child observe their peers working at centers. Observing their classmates gave each child a concrete, real-world experience from which to begin brainstorming. The CYC is equipped with one-way observation rooms which we were able to use for this experience; however, if necessary the children could have observed each other from within the classroom. For this stage, each child worked one-on-one with an adult. In order to have a small group experience, we pulled the children out of their classroom in four small groups — three groups of three children and one group of two children. These groupings remained stable throughout the process, and were created from our prior knowledge of children who we thought would work most symbiotically together.

We explained to the children that sometimes the best way for researchers to come up with new ideas is to look at old ideas and improve on them. This kept the children in the mindset of being researchers. Each child worked with an adult to watch their classmates' center activities. The children then drew what they observed in their research journals, and the adults annotated in words what the children were observing. Examples from the children's journals [see Figure 3] at this stage included such observations as 'Alan and Peter are playing Candyland' (Child's Research Journal, November 17, 2003) and a "Picture of Meg pretending to be a baby in dramatic play. She is crying" (Child's Research Journal, December 1, 2003)¹. These observations were simply what the children saw their classmates doing in the centers.



Figure 3: A journal entry from a child observing her classmates playing in centers (name removed to protect privacy of the child)

After the children drew what they saw, we asked them to draw ways to make centers "better" [See Figure 4]. The children came up with such creative ideas as "If you paint a flower, the painting will make the flower grow. If you paint the car, the car will grow" (Child's Research Journal, November 17, 2003), "New game center with new checker game: Checker board makes funny noises, sings songs, and talks. Checker board dances all by itself" (Child's Research Journal, November 17, 2003), and "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!)" (Child's Research Journal, November 21, 2003). We then explained to the children that they would later combine these ideas with the others in their small group to come up with even better ideas.

This stage was time-consuming as we purposefully pulled only as many children at a time as we had adults to work with them. It is important to note that at this stage, the

¹ All names of children have been changed to protect the children's privacy

adults functioned only to write what the children said for their journal pictures and to encourage the children to have lots of ideas in a brainstorming fashion where the ultimate feasibility of the ideas was not an issue. At this stage, the children were coming up with individual ideas that they considered “their own”. This was important as we moved into the next stage, where the collaboration among children and adults truly began.

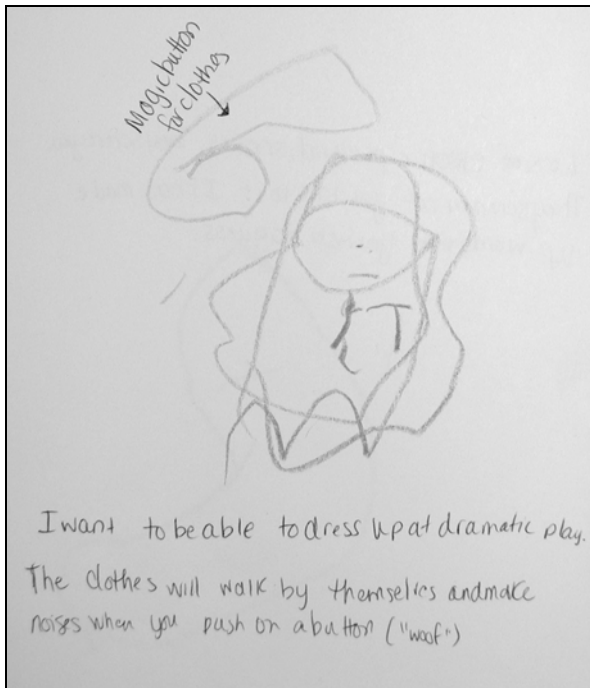


Figure 4: A child's journal entry of his idea for *magic clothes* for a Center of the Future

Stage two: Initial mixing of ideas

The next step after each child had individual ideas was to begin *mixing ideas*. We kept the initial idea mixing groups small in order to provide more structure for the children. Therefore, the first mixing was done within the children's original small groups so that only two or three children had to mix ideas together.

We had the children mix their ideas on table-size pieces of paper using magic markers. At the beginning of each session, we put out the children's journals open to the page with their individual ideas from the previous session. We had each child go over their ideas, not only to share with others, but to also remind themselves what their ideas were for making centers better.

In order to explain why we should mix ideas, we used the analogy of baking cookies. Each ingredient on its own may not taste good, but once all of the ingredients are combined, you get a tasty product that is better than each individual ingredient. Many of the children had experienced baking and could understand this concept. After all of the children had talked about their individual ideas, we asked them to

close their eyes and put all of their ideas into a “mixing bowl” and stir them up to see what came out. Some groups also offered the additional analogy of mixing colors, which they happened to also be doing in their classroom with food coloring and water. This demonstrated to us that the children understood the idea of mixing ideas together to generate new ideas.

The children and adults then talked about possible ways to mix ideas. Adults and children suggested various possibilities. Once the group had some initial consensus, the group created a name for the center in order to provide further guidance and structure. The results of these mixing idea sessions were four centers, one created by each small group [see Figure 5 for an example]: *Magic Funhouse*, *Magic Holiday Game*, *Storytelling Legos*, and *Zoo Center*.



Figure 5: A small group idea for a Center of the Future: *Storytelling Legos*

It was our original intent to jump directly to mixing the ideas of all four centers. However, in looking at how different all of the ideas were and that the children still needed a great deal of guidance in order to collaborate, we decided to add another step of combining ideas. Therefore we mixed the ideas of two of the small group centers into slightly larger group centers, thereby making two centers. While this added time to our process, we felt that it was necessary as the children might not see the idea elaboration as clearly if we jumped directly to the large group idea.

The adults in a separate meeting discussed which centers seemed the most alike and decided to combine the Magic Funhouse with Storytelling Legos and the Zoo Center with the Magic Holiday Game. The mixing ideas process worked much as it did above, with each of the groups of two or three children explaining to the other group what their center was. 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* [see Figure 6].

Stage three: Mixing the big idea

Once enough intermediate steps had been taken, it was time to mix the *big idea*. We had gone from 11 ideas to 4 ideas to 2 ideas; now it was time to combine to one. We believe that it was important at this point for the adults to play a larger role in the idea mixing, as the children were demonstrating a need for more structure as the mixing groups got larger. Before we had the children meet in a large group of 11, the adults discussed possible ways in which the two ideas could become one. This is not to say that we told the children how the mixing should happen, rather, this offered us possible roadmaps in preparation for our final mixing session.

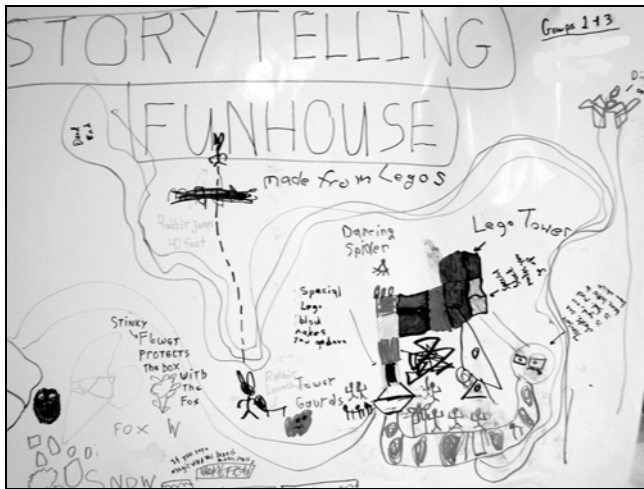


Figure 6: Storytelling Legos and Magic Funhouse mixed to become the Storytelling Funhouse

As before, we began with the children in each group explaining what their ideas were in order to remind them of their ideas and to enable them to assume ownership of their ideas. For this session, we had all of the children sit at a large, conference-room table. Instead of giving the children a big piece of paper with their idea on it, we cut up the idea into little manageable pictures and had the children rearrange them and put them together with tape as a way to begin thinking of how their ideas could fit together [see Figure 7]. By doing this, the children were able to physically manipulate their idea and the ideas of others. Then, we offered a new large piece of paper in order to draw one big, final idea.



Figure 7: The cut up and re-mixed big idea

The final idea was called the *Story Game Fun House* [see Figure 8]. Many interesting ideas came out of the large group mixing of ideas. The final design for this center of the future included an outdoor structure that had many rooms. The rooms were connected in many ways, including doors, tunnels, and moving stairwells. There was a concept that there could be a different game or task in each room and that the object was to complete all of the games in order to find a treasure.



Figure 8: The final big idea: the Story Game Fun House

It is important to note that many of the more specific ideas from earlier stages in mixing ideas may appear at first glance to be “lost” in the final big idea. One may then ask

why we do not just start with a big group idea. The reason is that all of the stages before are important as they spark imagination and innovation in children and adults. Although one child's specific individual idea may not be immediately apparent in the final idea, through the process of having that thought and the elaboration that occurred, each child and adult truly has had influence on the final big idea.

As mentioned earlier, it is always our intent in our research to push the frontiers both of the methodology used in creating technology for young children and the technology itself. To this end, we are currently examining technology that could be created based on what we discovered through this process of mixing ideas with our youngest design partners, and the final center that the team envisioned.

Currently, we are exploring ideas involving collaborative physical environments that can support connected physical activities in a structure. We are currently working on a prototype of Lego-type bricks that would be large in scale, suitable for outdoor use, and technologically enhanced. The bricks would be used in order for children to build semi-permanent rooms in which they could play. Once the rooms were built, they could be used for storytelling, game playing, or in any other way that a child's play house would be used. Some of the bricks could be programmable to enable children to build connections between rooms and to create games, stories, or puzzles within rooms. Our team is currently developing prototypes of this technology. We feel that this technology is a logical outgrowth of our previous work on programmable storytelling environments [19, 20], on work being done by others on technologically enhanced Legos [17] and work on outdoor interfaces for children [3, 24].

DEBRIEFING WITH THE CHILDREN: WHAT THEY THOUGHT OF MIXING IDEAS

In keeping with our philosophy of children as design partners, 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. In order to share this with us, they again drew in their journals and had an adult annotate their drawings. The most frequently discussed comments are shared below.

Likes: Drawing

The aspect that emerged most frequently from the children was that they liked drawing. Drawing was used often during mixing ideas, both by individuals sketching in journals and as a group on large paper. Most children at this age are not yet able to fully express their ideas clearly in writing, thus, drawing gives them a way to do so. Allowing an adult to annotate their drawings enables more complete expression of ideas, and the children are generally very willing to allow this to happen.

Likes: Mixing Ideas

Another aspect the children liked was simply mixing ideas. One child specifically mentioned combining ideas as his favorite part, while another mentioned his work on a center

that grew out of mixing ideas (the *Holiday Games*) as his favorite.

Likes: Observing people at centers

Two children mentioned they liked watching people in classroom centers. This was an important piece of the mixing ideas technique as it established for each individual child a basis for developing their original ideas, which were then mixed with others. This perhaps suggests that children were engaged in this design process from the very beginning.

Hardest: Drawing/Individual Idea-Generation

A few children also felt that drawing was the most difficult aspect of the process. When these children spoke of drawing, 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, which can at times be challenging for any design partner.

Hardest: Physically mixing ideas

Some children also identified mixing ideas as the hardest part of the process. In further discussion, they were specific in what part of the mixing was hard. One child found it difficult to tape ideas together; another had a difficult time drawing in the middle of the large paper. Therefore, what we discovered was that it may not have been the intellectual mixing of ideas that the children found difficult, but rather, the physical manner in which they had to do it. As such, we have begun brainstorming about what new and refined methods can be used in the future to make the physical act of mixing ideas easier.

Hardest: Nothing

Some children were at a loss when we asked them what the hardest thing was about mixing ideas. They replied with such comments as, "The hardest thing was thinking about what the hardest thing was. I thought everything was easy" (Child's Research Journal, December 19, 2003), or simply "Not hard" (Child's Research Journal, December 19, 2003). These children seemed generally perplexed that any part of the process could be perceived as difficult.

LESSONS LEARNED

Through the process of mixing ideas, we have learned a number of lessons about effective partnering with young children. We present these lessons below as suggested guidelines for others designing technology with young children.

Young children need more structure to collaborate during the brainstorming process.

The concept of mixing ideas grew out of frustration, both from children and adults, during the brainstorming and collaboration process at the CYC. With our older KidsTeam children (7-11 years old), oftentimes we have been able to brainstorm with minimal structure, sometimes even just by asking a thought-provoking question. However, with our child partners at the CYC, they needed a more concrete design experience that can also take place

during a short period of time to fit into to their preschool day. By encouraging idea-generation in smaller steps, and establishing collaboration parameters with others, the children were less frustrated and more productive in the brainstorming process. This is consistent with the literature on collaborative learning [21, 28].

It is important that each person feels they contributed their ideas.

Research has shown that participatory design can only be successful if the participants believe that their idea will likely be used [1]. The valuing of each individual's ideas in the mixing ideas process begins with the one-to-one adult-to-child ratio for individual brainstorming, and continues as each person or groups share their previous stage of ideas before mixing new ones. While older children may not need such explicit reassurance that their ideas are valuable, it is our experience that the younger children do and are more likely to participate in the design process in a productive way when they are supported in this manner. The challenge of this process is the number of adults needed for this kind of design and the amount of time it may take to re-hash previous ideas before moving on to mixing new ideas.

Drawing is an important bridge for young children to mix ideas.

Young children may have challenges expressing their ideas with words. While some of our youngest design partners can write, and we do not discourage them from doing so, we also do not require writing. We find that the ideas that come from children's drawings can be much more creative than what they may produce with limited writing skills, or even verbally. Even when a child wishes to write in their journal, we often offer to write down further explanation to be sure that the full idea is captured.

It is, however, important not to overuse one kind of drawing experience. Children will become bored if they are asked session after session to draw with crayons in their journals. Our child design partners drew in journals and on big paper, at tables and on the floor, using markers and crayons. Some subtle and simple variations in the approach can motivate young children to add more to their artwork and generate ideas.

Physically cutting and pasting offers another bridge for idea mixing.

No matter how much we varied the drawing, children did tire of this method of expression. In order to alleviate this, a method of cutting apart their previous idea drawings into small ideas enabled the children to tape them back together to establish "larger ideas". Adding these new processes sparked new energy and enthusiasm from the team. In addition, it offered another concrete way to represent the mixing of ideas.

One-on-one work between adults and children is an important part of the team process.

While not all teams have the luxury of having numerous adults on a design team, keeping the child to adult ratio low

for mixing ideas is beneficial. This helps the children to feel that their ideas are important and valued by giving them the full attention of an adult. It also makes the design team experience seem less like another classroom experience, which can enable children to feel free to experiment and contribute their thoughts. One-on-one work between adults and children can also ensure that the children's ideas are well communicated to and well documented by adults.

Adults need to remember to facilitate the mixing of ideas.

As with all Cooperative Inquiry techniques, adults need to remember that when mixing ideas, their ideas are as valuable as the children's. Sometimes adults do not elaborate on the children's ideas, yielding ideas that are highly creative yet probably impractical. Adults must learn, with as much tact as possible when working with young children, to gently elaborate ideas. The adults, like the children, are an integral part of the design process and need to know that their ideas are valuable!

CONCLUSIONS

The case study we have presented in this paper 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, even though it requires additional resources. More time and adult partners may be necessary to take full advantage of mixing ideas. In the future, we hope to compare teams with differing adult-to-child ratios to better understand the resources needed for this design technique. In addition, we would like to try mixing ideas with older children, to understand if this technique can be effective in other design circumstances. Finally, we intend to pursue the development of technology based on the *Story Game Fun House*. Through technology implementation and further empirical study we expect to better understand the benefits of mixing ideas with young children. We feel that the technique of mixing ideas can be effective within the Cooperative Inquiry method to generate new ideas for children's technology.

ACKNOWLEDGMENTS

This work could not have been accomplished without an NSF Career award and an NSF CRCD award to support our research on *The Classroom of the Future*. In addition, we appreciate the on-going collaboration of our child design partners at the CYC. We also are grateful to the CYC's Director, Dr. Fran Favretto, and teachers Rona Koppang and Tina Winterich who continue to support our research in so many important ways.

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