The Social and Cognitive Experiences of Child Design Partners

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Many researchers have explored the effects of involving children in the technology design processes on the resulting technology; however few have investigated the impact that this design process participation might have on the child design partners themselves. Using a case study method, we explored the social and cognitive experiences of children involved in a Cooperative Inquiry technology design process in partnership with adults over a one year period. Findings indicated that children involved in the technology design process in partnership with adults had social and cognitive experiences in the areas of relationships, enjoyment, confidence, communication, collaboration, skills, and content.

1. Introduction

While there is educational research that discusses the proliferation and impact of technology use among children both at home and in school [9, 19], there is an aspect of children's technology that is sometimes overlooked: the design of technology. Although all technology must first be designed and then implemented, it is uncommon that children are an integral part of the design process. Research has shown that children can be involved in technology design processes in variety of was [4]. The current study does not question this involvement, but rather considers how children's participation in the design of technology may influence and impact their lives both socially and cognitively.

There are many extra-curricular options available for today's children. Why should a child and her parent choose to participate in a technology design team, rather than play soccer, or learn to play the piano? Certainly soccer can bolster a child's physical skills, and learning to play the piano can help children musically and mathematically, but what will a child experience by being part of the technology

design process? The work we present here offers an understanding of the cognitive and social experiences of a group of children who participated in a technology design process.

In this work, we focus on children who are design partners with adults in the creation of new technology. Design partnering suggests a deep involvement for children in the technology design process. In design partnering, children are respected team members and stakeholders with adults in the design of new technologies (see Figure 1). A child design partner is "…a part of the research and design process throughout the experience" [4, p.19]. We believe that this deep and prolonged involvement with the technology design process may lead to rich cognitive and social experiences. This work focuses on uncovering those cognitive and social experiences.

Figure 1: In design partnering, adults and children work together to design new technologies

2. Related Work

Although children's technology has existed for decades, the concept of working with children as design partners in the technology design process is relatively new. Research which discusses the process of including children as technology design partners tends to focus on two issues: (1) the technology design process and (2) the product or technology that resulted from the design process.

Articles that discuss children and technology, even if they do not dwell on design process, may imply how children interact in the design process and their experiences in this process. In examining the related work, we will cover the literature that mentions these experiences. For a more comprehensive view of this body of work, including the experiences of informants and software designers, see [13]. In this related literature, the focus of the researchers was not to investigate the impact of the design processes on their child design partners. Rather, impacts on children were mentioned as an aside or afterthought; something that the researchers became interested in during the process.

2.1 Informal methods

The authors of previous studies gathered information about potential impacts on design partners in an informal manner, in addition to or as an aside to the other research at hand. Thus, this information indicates that researchers are interested in how our design partnering may affect our child design partners, but have yet to explore this notion in a more formal, rigorous manner [14].

The informal methods described when reporting potential benefits to children who were design partners fell primarily into three types: observation, verbal and informal self-reporting, and implication. The first and most prevalent was observation [2, 6, 8, 12, 15, 16, 17, 18, 27, 36, 37]. Observation as a method for gathering data on the potential benefits to children involved in technology design processes was often reported in papers whose primary focus was the process of designing technology or the technology itself. This may be due to the method's more non-intrusive ways in which to gather data. The

second method was verbal and informal self-report in which children were asked about their experiences as a design partner in varying ways [3, 4, 5, 7, 10, 20, 28, 31]. Finally, there are instances in which researchers imply benefits that do not result directly from the research [30, 32, 38].

2.2 Potential benefits to child design partners

If we compile these informal findings, various potential benefits to child design partners emerge. The first set of these assumed benefits may be considered **social**. These include an improved ability for children to *collaborate* [3, 5, 7, 11, 15, 28, 31] and *communicate* [3, 5, 7, 16, 28, 31]; as well as feelings of *empowerment* [4, 5, 12, 17, 32], *pride* [16, 17, 20, 27, 31], and *confidence* [4, 8, 27, 28, 31].

Researchers also suggested potential **cognitive** outcomes as a result of participation in a design process. Many different types of *content learning* have been posited, including learning about animals [3, 28], reading or mathematics through technology immersion [2], improving English as a second language skills [18], and curricular skills [30]. When design partnering is used in a classroom setting, teachers have remarked on its ability to improve independent learning in children [31]. Six studies reported an improvement in understanding for children in the content area of *technology* [3, 7, 10, 11, 27, 31]. These improvements included children learning about technology, or gaining confidence or skills in using technology. Finally, many researchers mentioned that children appeared to learn about the *design process* itself [3, 6, 10, 28, 37], while one paper mentioned learning about the more general *invention process* [7].

Also mentioned in the literature are a few instances of discussion concerning the following benefits: providing a *challenge* [4, 5], *problem solving* [10, 31], *writing* [31], *drawing* [2], learning *respect* for other design partners [3, 28], improved *behavior* [31], improved *creativity* [38] and having *fun* [21, 36]. Based on these initial findings from the literature, we began our formal study examining the social and cognitive experiences of child design partners.

3.0 Method

Our research focused on the question: What are children's social and cognitive experiences in the context of an intergenerational Cooperative Inquiry technology design process? As suggested in previous work [14, 33], complex research questions may best be answered using qualitative methods. The method for this research was a year-long, participant observation case study of the co-design process of child design partners on a technology design team.

3.1 Cooperative Inquiry

The context for this research was Cooperative Inquiry, a method of design partnering with children. A complete description of the Cooperative Inquiry method, which is beyond the scope of this paper, can be found in [3, 4]. Cooperative Inquiry is a method for designing technology in which children and adults work together as design partners. Children are equal members of the design team with adults, and work over a number of years using a variety of techniques such as low-tech prototyping and sticky note critiquing in order to design technology. A year of the Cooperative Inquiry design team includes two full-time weeks of design sessions in the summer, followed by two 90-minute sessions per week during the academic year. During the year of this case study, child design partners were involved in the design of numerous technologies for children, including digital libraries for iPod touches, websites for partners such as the United States National Park Service and the People in Need Website in Haiti, and mobile storytelling applications.

3.2 Participants

The team included eight children and a rotating mix of adults, and was located in a lab setting. This was a case study of a bounded system defined as the experiences of the children for one year. Each individual child was not a case; rather, their experiences as a whole defined the case.

The eight design partners who participated in the study were three boys, and five girls. The children all lived in a twenty-mile radius of the campus where the team met. This was necessary as they attended design team meetings twice weekly on the university's campus. The group was ethnically diverse in nature, including two Caucasian children, two African American children, and two children of mixed race. The children ranged in age from 7 years to 11 years old. Of the participants, four were in their first year of design partnering and four were returning members of the design team. (See Table 1 for summary of the demographic information of the children.)

Table 1. Demographic information of children in the case study (*names of participants have been changed*)

Name	Gender	Age	Experience
Abby	F	8-9	Returning
Barrett	M	9-10	New
Cameron	F	7-8	New
Dakota	F	9-10	Returning
Nikita	F	8-9	New
Sebastian	M	10-11	New
Shawn	M	10-11	Returning
Tabitha	F	8-9	Returning

In addition to the child participants, one or both parents of each child design partner participated in interviews at the end of the design team experience. Parent(s) of all children were interviewed. The data gathered from one interview – that of Dakota's father – was excluded due to a conflict of interest.

3.3 Data Collection

The case study involved multiple sources of data collection, including participant observation, artifact analysis, and interviews. All data collection occurred concurrently, with data being continually analyzed and coded, with each type of data informing the others.

3.3.1 Participant observation

The first method of data collection for this study was participant observation at design team sessions. Participant observation involves researchers who are a part of the process, in this case adults involved in the design team, observing the process. This occurred during one design session per week throughout the study. Because the sessions were 90 minutes long and included relevant interactions and activities throughout that time, collecting data at one session per week (totaling twenty 20 sessions) provided a large and saturated set of data. The data collected during participant observation consisted of observational notes, photos, and videos of the sessions.

Notes were taken on phenomena that were informative to the study including noting social and cognitive behaviors of children. This open-ended observational technique allowed categories of interest to emerge without pre-determining what the outcomes were to be [25]. Photos and videos of relevant experiences were also taken and collected. Photos and video were informative in addition to field notes as they are more able to quickly capture potential information such as body language or facial expression, which may help to describe social experiences, as well as the physical setting of the experience [23]. During the course of the case study, 297 unique observational notes were collected. During the design team sessions, the total number of photos taken was 184, and 43 unique clips of video totalling 96 minutes were taken.

3.3.2 Artifact Analysis

At the most basic level, artifacts refer to the things that people create [22, 34], and can help to paint a richer picture of the studied phenomenon. The techniques used in Cooperative Inquiry design partnering provide a set of artifacts, such as low-tech prototypes for nearly every design session. Additionally, the children's personal design team web pages and posters created by the child design partners to recruit future design partners were collected and analyzed. 119 artifacts were collected and analyzed.

3.3.3 Interviews

Each child design partner and his or her parent(s) were interviewed at the end of the year of design team. The interviews were conducted using an initial uniform protocol. Interviews of child design partners and their parents were conducted separately in order to ensure that their responses did not influence one another. Interviews were deliberately open-ended but systematized, which allowed for both a conversational and informal feel to the interview, which encouraged sharing of information, while also providing points of comparison among participants. Interviews focused on the experiences children had, and their parent's perceptions of them, during the design process year.

Eight interviews with children were done which totalled approximately 75 minutes. Seven interviews were conducted with a total of ten parents. Four were with individual parents and three with both of the child design partner's parents. The total time of the seven parent interviews was approximately 137 minutes.

3.4 Data Analysis

The method for coding and classifying the data for this study can best be described as categorical aggregation [35] whereby data were classified as they were reviewed by looking for themes, in this case, cognitive and social experiences. Codes were developed inductively as the data were gathered [26], that is, there were no pre-set codes developed before the data were collected, which allowed for codes to emerge naturally from the data to provide a participant-generated classification scheme. Although we had undertaken a thorough literature review of related work, it was our intent and practice to allow codes to emerge from the data with no preconceptions, including accepting surprising or unexpected codes, and also accepting non-emergence of codes that we may have anticipated. Data from all sources – participant observation, artifact analysis, and interviews – were reviewed in order to ascertain if findings from one type of data supported the others.

All three types of data produced several codes. Coding of the participant observation data resulted in for 1,236 coded references from observational notes, 956 from photos, and 600 from videos. Coding of artifacts resulted in 1057 coded references. From the child interviews, there were 394 coded references. From the parent interviews, a total of 509 references were coded from the data.

NVivo software, designed to aid in managing data for qualitative research, was used for management of coding schemes. For ease of analysis, participant observation notes, interviews, and videos were transcribed. Photographs were analyzed, including photographs of certain artifacts including low-tech prototypes. The entire data set was initially coded in thirds, with meetings between each to discuss and review the emerging codes. After the data had all been coded, the entire set of data was re-coded two more times for a total of three coding rounds, at which point the codes were saturated and no further codes were emerging.

4.0 Findings

Ultimately, the data offered a rich description of children's experiences as technology design partners. A framework emerged for describing the cognitive and social experiences of children involved as design partners in the Cooperative Inquiry process. This framework can most easily be visualized as a Venn Diagram (See Figure 2), with three constructs solely within the social domain, two constructs solely within the cognitive domain, and two constructs which overlap the social and cognitive domains.

While this framework is broken down into constructs and domains, it is important to note that due to the holistic nature of the Cooperative Inquiry design process, these findings should be considered in their entirety as they describe the experiences of Cooperative Inquiry design partners. It is not our intent to segregate the findings, but rather to provide a picture of the Cooperative Inquiry design experience for the child design partners.

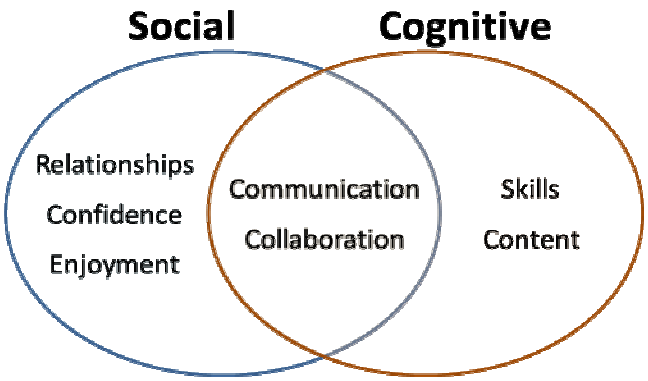

Figure 2. The social and cognitive experiences of children involved as technology design partners

Figure 2 illustrates the seven principal constructs that emerged from the data, and into which domain each falls. The constructs that emerged within the **social** domain were relationships, confidence, and enjoyment. In the **cognitive** domain, the constructs that emerged were skills and content. The skills construct has subcategories of reading, problem solving, and application; the content construct has subcategories of technology and discipline-specific content. Finally, the constructs of communication and collaboration bridge both the social and cognitive domains. In this section we present a brief overview of each of these seven constructs.

4.1 Social Experiences

Social experiences in this research were defined as socialization, including relationships and independence, and the areas of self-esteem and self-regulation [1, 29]. As codes emerged in the social realm, the data fell into three categories: relationships, confidence, and enjoyment.

4.1.2. Relationships

The social category with the most data was relationships, which referred to the quality of interaction between design partners, child and adult alike, as well as how the relationships were experienced as pairs and within both the small and large groups. Additionally, children demonstrated that within

relationships, they enjoyed helping others during design team and felt a level of comfort with the design team relationships. These speak to the quality of the interactions within the relationships.

The children expressed that relationships with other children were an important part of the design partnering experience. For example, on his personal design team web page, Sebastian stated, "What I do in [design team] is be *(sic)* creative and make friends". In his end of the year interview, Sebastian further explained, "It's like everybody's like friends with everybody…like for real". Sebastian's experience with the other design team children as friends was typical of the children on design team. When asked if their relationships with children on design team were different from relationships with other peers, the children generally responded no. They identified the children on the design team as their friends.

Relationships for this study were defined not only as interactions with peers, but also the children's relationships with many different adults, including adult design partners and partners from outside of the design team. Unlike those with their peers, the relationships children experienced with adults on the design team seemed to be different from those that children had with adults outside of design team, such as teachers. During her interview at the end of the year, Dakota remarked, "The teachers [at school] tell you more what to do, than [on design team]…from like the adults there because they're just giving you ideas and suggestions". It seems as though the breaking down of power structures between children and adults working as design partners impacted the ways not only that adults and children interacted, but also how the children viewed these relationships.

Although adults and children work together as design partners, there is still an element of support from adults to children. The children seemed to internalize this, for example, when Tabitha was asked why she enjoyed working with adult design partner Greg, she said, "…Um, Greg makes me feel – he, he, he makes me feel like I'm like good at something". During observations of design sessions, adults were often heard to say things like "That's a good idea!" or "I like it!" in response to a child's design efforts.

4.1.2 Confidence

Confidence emerged from the data as a frequent experience during a child's participation in the technology design process. Confidence as a social construct can be an outward expression of a child's self-esteem. This construct emerged from many types of data, from noting the quality of the children's expressions during sessions, to direct statements of child design partners regarding confidence, to parents stating during interviews a feeling that their child demonstrated increased confidence as a result of being a design partner. Confidence manifested during the design team sessions in outgoing behavior and demonstrations of empowerment.

One child in particular, Nikita, seemed to most of the adult design partners to be less outgoing at the beginning of the year. She was new to the design team during the year of the case study, and as the year progressed, it seemed that she became more outgoing during the sessions. In the end of the year interview, Nikita's mother said, "She always kind of considered herself to be a little bit shy. Now, I can't say, I can't say I can definitely attribute it to [design team]...I don't know, but I think she's becoming more outgoing with adults, like more expressive." Nikita corroborated this, saying that [design team] had helped her with "speaking up." As the year progressed in design team, observations showed Nikita more often volunteering ideas and speaking up in small and large group situations.

In their interviews, parents often spoke of the empowering nature of design team. Barrett's father stated, "I just think it's really cool that as kids, you know, right away, their input's important. So he's gonna, as he grows up, he's gonna feel like…what he has to say is important." Barrett also felt this empowerment, writing on a sticky note expressing what he liked about design team, "Doing stuff that's helpful for others". Parents of design partners indicated that the work that the design team did with outside professional partners, such as the United States National Park Service, were important in making design team an empowering experience for the children. Rather than explaining a feeling of empowerment, the children articulated this as a feeling of pride. In this study, it appeared that children

indicated that they felt proud as a result of the empowerment experienced on the design team. When asked directly "How does being on [design team] make you feel?" Abby replied "Proud!".

Additionally, children demonstrated increased confidence in relation to their interaction with technology. Many of the parents mentioned noticing their child's confidence with technology. They commented specifically on their surprise at their children's abilities and comfort in using computers and going online, and their lack of fear in doing so. Some parents saw this as entirely positive, while others were more wary, such as Sebastian's father, who, when asked if Sebastian had learned anything from design team stated, "Computers. [Sebastian] has become very confident with computers. And… [long pause]…Way too confident [laughing]."

4.1.3 Enjoyment

Enjoyment, defined for this research as experiencing pleasure, joy, or fun, is an elusive entity to capture and measure. It is difficult to know, at any given time, if someone is enjoying herself. However, the qualitative methods employed for this study and the wide variety of data, allowed enjoyment to emerge as one of the most prevalent categories mentioned in all types of data. This was through children using words such as "like", "enjoy", and "fun". Data was also coded for enjoyment when children physically indicated that they were enjoying activity, through laughter or smiles (see Figure 3). Enjoyment was included in the social category as it generally was coded in tandem with other social constructs.

Figure 3: Adult and child design partners enjoying their work together

Some of the most obvious examples of enjoyment were found in the artifacts that the children produced throughout the year, which asked them to reflect on their experiences as design partners. For example, in the poster they created to recruit future design partners, Shawn, Barrett and Sebastian included the statement, "You have to be fun!". One of the questions they were asked to answer on the webpage was, "What do you like about being on [design team]?" To this, Cameron responded, "It's really fun and you get to use technologies and there are really nice people". The parents noted the enjoyment that the children had as well. During his interview, Barrett's father remarked, "Yeah, well, he enjoy – I mean he enjoyed the whole thing. He never had any desire not to go or anything."

4.2 Cognitive Experiences

Cognition is a broad term, which at its base involves the acquisition and use of knowledge. In addition, cognition can include thinking, content knowledge, creativity, motivation, and achievement [24]. All of these areas come together to form the complex process of cognition, and to inform the definition of cognitive experience for this work.

The cognitive experiences that children showed in the data during technology design processes emerged in two main categories: *skills* and *content*. Within both categories, further subcategories emerged. Data were coded for skills when they demonstrated that children participated in experiences that could aid in acquiring, working with, or using knowledge. Subcategories of reading, problem solving, and application (using experiences on design team in another setting) emerged from the data in the construct of cognitive skills. Content, referring to content knowledge, contained the subcategories of technology content and discipline-specific content.

4.2.1 Skills

Reading was a skill child design partners were encouraged to employ, but not forced to use, during design team activities. Reading while on the Cooperative Inquiry design team included children reading

both silently and aloud. For example, Cameron would often read from her journal in order to present her ideas, and Nikita once began spontaneously reading a website that was displayed on a large screen to the whole group. Reading could occur to gather information, or in service of the design process such as reading design notes out loud to the group. Child design partners also had many opportunities to practice the skill of reading when developing a storytelling technology for the iPhone. During this design activity, children had the opportunity not only to write and read their own stories, but also to read others' stories.

Problem solving was the most prevalent cognitive skill that emerged from the data. The focus of design partnering is to solve problems. Each design session included challenging issues that the team needed to work together to solve. The data showed there were many types of problem solving undertaken during the design process. These included: inquiring, brainstorming, using creativity, critiquing, being challenged, and focusing.

Sebastian's mother noticed the problem solving that occurred in the design team environment. She appreciated Sebastian being able to see how the adults on the team used inquiry as a method of research. As she explained it, "He could – with [the design team] he had an experience where he could go to the university and see oh, these are, these are grown-ups…and they're asking questions…and they're trying to find answers…and they're experimenting, and they're collaborating".

For the purpose of this research, *application* was defined as the children taking experiences they had on design team and utilizing them in another activity such as school or extracurricular activities. Data regarding the application experience could not be collected through observational notes or artifact analysis, as these data collection methods were tied to the context of design team sessions. Rather, data for this code emerged exclusively through parent and child interviews. Four of the children said they did, four said they did not, apply what they had experienced on design team in other situations. Many of the parents saw applications of design team experiences to other situations.

Abby, Cameron and Dakota all mentioned using technology such as the iTouch or computers in school, as did Sebastian's father, and saw a connection to design team in this technology use. Abby's mother and Barrett's parents both mentioned a kind of confidence that they felt their children experienced on design team was now found in other areas of life, such as on swim team and at school. Nikita's mother felt that the reading and writing that Nikita experienced on design team carried over to her experiences at school, and that the practice she was afforded in reading and writing during design team sessions may have had a beneficial effect on these skills in other environments. Parents and children alike, including Barrett, Tabitha's parents, and Cameron's father, mentioned the idea of working in a team as applicable to other situations outside of design team.

4.2.2 Content

The second area in which child design partners had experiences within the cognitive domain was in content. For the purposes of this research, cognitive content included experiences that could lead to acquisition of knowledge. Content, referring to content knowledge, contained the subcategories of technology content and discipline-specific content. Discipline-specific content further broke down into process as content and subject content. While data from this study does not prove that learning of content arose from participation in a Cooperative Inquiry design process, it does indicate that experience with content was provided, and thus, the opportunity for content learning existed within the context of the technology design partnering process.

The largest subcategory regarding content was technology. The definition of technology for this work was intentionally broad. Technology content was experienced when child design partners interacted with technology such as a computer or electronic device such as an iPhone or Wii. Although teaching child design partners about technology is not one of the express goals of design partnering, some of the children interpreted it as a part of the process. For example, part of Cameron's explanation of design team was**, "**It's a place for kids to kind of um, learn about technology…". Technology content

also included comfort in interacting with technology. Cameron's father listed as one of his expectations that Cameron would become more comfortable with technology. He explained, "...my sense is that she's gotten more comfortable with the concept of uh, of internet searching, and of uh, looking to technology both you know software and online…for answers to things…".

Along with experiencing technology as content, there were codes that emerged from the data regarding discipline-specific content, that is, content about a particular topic. Discipline-specific content was categorized into two main groupings: subject content, or content about a particular topic; and process as content, or learning about the processes, such as brainstorming, used in being a design partner.

In subject content, child design partners were exposed to content about the topics for which they were to design technology. For example, on a project to help the United States National Park Service design games to teach children about oceans, the children were exposed to information about oceans, and during a project helping to design a website intended to support communication between children in the United States and in Haiti, the children were exposed to information regarding the living conditions of children in Haiti. When asked what she liked about being on design team, Cameron replied, "I also liked, um, the [United States National] Park Service and all the other ones, but the Park Service was pretty cool too, because I LOVE learning about history". When asked what she learned about history, she continued, "We've learned about the, um, the sunk boat…and we learned about the Underground Railroad…", listing topics about which the design team designed technology.

In addition to subject content, another type of discipline-specific content that occurred during design team sessions was process as content. In this case, the process was the process of designing, which, as described earlier, included facets of problem solving, cooperation, communication, and many other skills. Parents especially mentioned this piece. Barrett's father remarked, "I think some of the processes, the thinking processes, and the way to apply yourself in a situations…is some of the more

valuable things he's been learning". During her interview, Sebastian's mother supported this notion, saying, "I think that one of the important thing about research educationally…in a model like [design team] is it supports that importance of the process piece of learning".

The intent of design partnering is not to teach the children specific content; rather it is to design technology. Thus, any content that the children experienced, in reference to technology, process, or subjects, was not taught directly, it was rather experienced as a secondary outcome.

4.3 Social and Cognitive Experiences

Over the course of the case study, the data showed that child design partners had experiences that often did not fall neatly into the labels "social" or "cognitive". The social experiences enumerated above focus on socialization. The cognitive experiences involve acquisition and use of knowledge. Some of the experiences of the children overlapped these two domains and had characteristics of each, specifically the constructs of communication and collaboration. Both communication and collaboration involve an inherently social aspect in that they nearly always require more than one person to occur. However, both of these constructs can also be employed in acquiring and using knowledge. Hence, they both sat at the intersection of the social and cognitive domains.

4.3.1 Communication

Communication in this study referred to intentional attempts by child design partners to convey information to others. Communication is a skill experienced by children who are design partners. All design partners need to be able to communicate their ideas to the other members of the team. The communication on design team differed in some ways from that which children experienced in other contexts. Communication was further broken down into subcategories of verbal, visual, and textual. Opportunities to practice many forms of communication were plentiful during design team sessions. The diversity of communication forms were in part a result of the nature of design team activities, which required demonstrating, describing, explaining, clarifying, and defending ideas.

Every session of technology design partnering required the children to communicate ideas. They had the opportunity to communicate in many ways. Sometimes they needed to communicate an idea they built verbally to an adult design partner. Sometimes, within a small group, the children needed to communicate ideas verbally with one another in order to create a group written product (see Figure 4). They also needed to communicate verbally when presenting ideas to the large group.

Figure 4: Child design partners verbally communicating in order to brainstorm ideas for a design activity

During design sessions, there were many opportunities for children to communicate their ideas in a visual manner. Visual communication for the purpose of this study was defined as communicating ideas through drawing or use of other three dimensional art media without the use of words or text. Examples of visual communication often emerged from journals or low-tech prototypes. Likewise, textual communication occurred when children used written words to communicate ideas. This type of communication occurred most frequently in journals. Many artifacts (see Figure 5) included both a visual and a textual component.

Figure 5. This journal entry of a child design partner's idea for a new website includes examples of both visual and textual communication

4.3.2 Collaboration

Collaboration for this study was defined as working together toward a common goal. In the context of Cooperative Inquiry design partnering, the goal was most often to design a technology. Collaboration is inherently a social activity that contained the possibility of transmitting and/or gaining knowledge, hence its inclusion in the intersection of the social and cognitive domains.

In every interview, both parents and children mentioned collaboration. This was despite the fact that there was no directed question in the interview protocol regarding collaboration while design partnering. Abby explained that a design partner is "...a kid that, um, that works together um to build things…", while Cameron explained, "At [design team] you work with other people to figure out even better new ideas." Tabitha's mother noted, "I think another –another part of what the design partner does is that they become a part of a team".

The types of collaboration that child design partners engaged in varied. They collaborated in groups of only children, and in groups of adults and children (See figure 6). There were instances of pairs, small groups, and large groups collaborating.

Figure 6. A small group of children and an adult collaborating on a design problem

5.0 Contributions

We believe this work makes an important contribution to researchers in the area of technology design processes, especially for researchers working with children. This study investigated the developmental impacts on children who were deeply involved in the process of designing technology, which we believe adds a dimension to the discussions of participatory design. Prior to this research, there had been no formal study investigating the experiences of children who participated in a technology design process. The incidental mentions of these experiences supported the notion that children involved in technology design may experience social and cognitive experiences while on a technology design team, and also indicated that the community of researchers in this area was interested in this topic. The study conducted here begins to provide information on the cognitive and social experiences of children who are intimately involved in a technology design process. These cognitive and social experiences were demonstrated in this study of child design partners involved with the Cooperative Inquiry design process.

There are also implications of this work for designers of children's technology. Designers often consider the best and most efficient ways to create technology in choosing a design method. The current

research suggests that if a designer considers the social and cognitive experiences found in this research to be positive, then choosing to work with children using Cooperative Inquiry or another method of design partnering may not only benefit the technology created, but also has the potential to provide positive experiences to the children involved in the design process. Therefore, it is our hope, given the social and cognitive experiences that children can have during a design partnering process, that more designers will consider working with children as design partners.

6.0 Future Work

As this research was an initial investigation into this field of study, it has laid the groundwork for future work in the area of designing technology with children and the experiences of those children. We believe the strongest results will occur when multiple researchers in many locations undertake similar research. If researchers across the world were to undertake investigations of the nature of children's cognitive and social experiences while participating in technology design processes, the results could be compared.

Furthermore, it would be informative for the literature in this area if researchers not only with design partners, but also informants, testers, users, those working in bonded design, and those working with children as software designers, would similarly investigate the cognitive and social experiences of participants in those design processes. The results could then be compared to these and we might see trends, differences, and similarities in the nature of children's experiences with all of these processes.

There are additional lines of research that could be pursued to further the findings of this study. One path would be to retroactively study participants who were design partners in the past. Our team has been in existence for fourteen years. We maintain contact information on our past design partners, and an interesting endeavor could be to reconnect with past design partners to discover what they are doing now, albeit with careful attention paid to retroactive memory issues. Similarly, a longitudinal study that

followed a group of design partners over a multiple year period of study could be valuable to understand the long-term impacts of being a part of a Cooperative Inquiry design process.

The main contribution of this work is a model that describes in detail the social and cognitive experiences of children who participate in a Cooperative Inquiry design process. It is our hope that other researchers will continue to examine the important issues of how the children we work with in our design processes experience this process.

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