Embedding Participatory Design into Designs for Learning: An Untapped Interdisciplinary Resource?

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Abstract: Given the rapid evolution of social networks and online communities, interest in participatory cultures—online and offline social spaces with low barriers to entry and support for creating and sharing knowledge—is increasing. Design-based research (DBR) that invites children to share in the process of designing the technologies that support their learning is a natural extension of this participatory cultures movement. In this symposium, we establish a rationale for using Participatory Design (PD) techniques that can inform and enrich the process of designing technologies that support collaborative learning. We provide empirical examples from our own research of the ways in which PD can be incorporated into learner-centered technology designs. Our experiences demonstrate that PD is not only a key contributor in the design of learning technologies themselves, it can also be valuable resource that sheds light on the learning processes of the children who use them.

Introduction

Participatory Design (PD) is an array of theories, practices, and research methods whose core philosophy is to include end-users as active participants in the technology design process (Muller, 2008; Schuler & Namioka, 1993). Our symposium's integrating theme is the notion that PD can be a valuable resource for researchers engaged in design-based research (Hoadley, 2002) throughout the learning sciences: one that may enrich the process of designing technologies that support collaborative, socially constructed learning, and also benefit the learners who participate in their design. Yet, a review of current research across the learning sciences reveals that PD is a largely untapped resource in design-based research (DBR) studies. A handful of researchers across the learning sciences and human-computer interaction (HCI) have been engaged in design-based approaches that closely resemble each other in that they invite the children being studied to be partners throughout the iterative design process (e.g, Ahn, Gubbels, Kim & Wu, 2012; Barab, Thomas, Dodge, Carteaux & Tuzun, 2005). Although these pockets of potential exist, we have not yet enjoyed cross-pollination among these parallel research tracks. Our symposium is a first step in building a deeper dialogue among researchers in CSCL and HCI that can lead to an integrated, interdisciplinary research agenda that incorporates PD into broader DBR frameworks. In particular, we focus on the potential benefits of enlisting children as full partners with adult researchers and designers, throughout the design process of a learning program or system. Our goals are to explore 1) why PD methods hold such promise to augment existing DBR approaches, and 2) how PD techniques can be integrated into DBR projects.

Background

PD grew out of the Scandinavian trade union democracy movement of the 1970s, where its initial contextual focus was the workplace, with the goal of giving union workers a greater voice in the design of computers that they were required to use (Bødker, Ehn, Sjögren, & Sundblad, 2000). The primary motivation for PD is the democratic ideal that the people who are affected by a decision or event should be given the opportunity to influence it. A key corollary is that the goal of technology design is not to "automate the skills of human workers," but "to give workers better tools for doing their jobs" (Schuler & Namioka, 1993, p. xi). PD is sometimes used synonymously with the term, co-design (cooperative/collaborative design); however, co-design emphasizes a more in-depth, and often equal, partnership between designer and end-user, and enlists user participation at earlier stages in the design process (Bødker et al., 2000; Walsh, Foss, Yip, & Druin, 2013).

While PD was created initially in a sociopolitical context, its use has been extended to many other user populations, such as children (Druin, 1999, 2002), individuals with disabilities (Frauenberger, Good, & Keay-Bright, 2011), and older adults (Ellis & Kurniawan, 2000). As the diversity of user populations engaged in PD has grown, its methodologies have also been extended to design-based research contexts outside the workplace, such as urban planning and policy (Friedman et al., 2008), social media (Hagen & Robertson, 2010), and education (Barab et al., 2005). In general, PD approaches such as Contextual Inquiry (Holtzblatt & Jones, 1993) evolved from working with adults during technology design processes. Similarly, Cooperative Inquiry adapts and extends PD techniques; however, the users who partner with design researchers in Cooperative Inquiry are children, not adults (Druin, 1999, 2002; Guha, Druin, & Fails, 2013).

In PD projects that develop technology for children, children can assume various roles, usually at specific points in the design process (Druin, 2002). For example, a child can evaluate a system as a user and tester (e.g., near or just after design completion), or as an informant (e.g., early in the design cycle). In Cooperative Inquiry, however, children act as full partners with adult designers throughout the design process (Druin, 2002). Child designers, typically between the ages of 7-11, are actively involved in technology design from conception to completion, sharing ideas and evaluations equally with the adult members of the team. Likewise, adults play active roles throughout the process by first helping child designers generate and articulate ideas and then synthesizing those ideas into manageable designs. Cooperative Inquiry enriches PD research with techniques that enable teams of children and adults to share ideas in ways that maximize idea elaboration yet minimize differences in age, ability, and communication styles (Druin, 1999). For example, "Bags-of-Stuff" is a Cooperative Inquiry technique in which art supplies are used by intergenerational design teams to build low-tech prototypes of the technologies they envision (Walsh et al., 2013). Because of Cooperative Inquiry's emphasis on equal partnership, it is also referred to as co-design. However, it is important to emphasize that Cooperative Inquiry is a specific co-design method that includes children as equal partners with adults. All of the learning design projects presented in this symposium were informed by co-design approaches.

Participatory Approaches in the design of Learning Environments

In many ways, the user-centered core of PD approaches is closely related to the ideals underpinning learner-centered theories and methods developed in the CSCL research community. Both are founded on the principle that their target populations (end-users and learners) are best served when they are given a high degree of agency in the process under investigation (technology design or learning). Each embodies the participatory cultures movement, emphasizing the cultivation of knowledge communities in which content and expertise are co-created (Jenkins Clinton, Purushotma, Robinson, & Weigel, 2006). Still, few CSCL studies seem to have integrated PD techniques (Barab et al., 2005). Existing studies also enlist learners in limited design roles (e.g., informant and tester), rather than the full spectrum of PD roles available—especially that of equal partner. Others focus on how adult educators, not child learners, can be co-opted into the design process (e.g., Hernandez-Leo et al., 2006).

Even the limited research that has employed PD promotes the value of such techniques for learning. For example, Stanton, Neale, and Bayon (2002) combined the educational goal of learning collaboration skills with the PD philosophy of giving children as much control as possible during their extended development work with KidPad, a drawing application adapted for use with multiple mice and tangible interfaces (Druin, Stewart, Proft, Bederson, & Hollan, 1997). KidPad enjoyed sustained successful use in primary schools in the United Kingdom for at least three years (Stanton et al., 2002). Quest Atlantis (QA), a multi-user virtual environment (MUVE) developed by Barab et al. (2005) to better understand the role of online community and games in supporting academic content learning, combined elements from methodological approaches in critical ethnography, participatory action research, and PD to develop a "critical design" philosophy (Barab, Dodge, Thomas, Jackson, & Tuzun, 2007). The QA research team attributed their success to their cultivation of "rich relationships with [children] we came to regard not simply as 'participants' but as 'collaborators'" (Barab et al., 2007, p. 280), which also resulted in a collaborative interface that was effective in supporting academic goals. More recently, PD-like approaches with adult educators have shown promise in fostering the design of novel participatory assessment systems (Itow & Hickey, 2012).

The collaborative and cognitive benefits of design thinking have also been touted in learning contexts. Research in game-based learning, game design, and e-textiles design has demonstrated the problem-solving expertise and increased agency children can derive from their active participation in these projects (Kafai, 1996; Kafai, Fields, & Searle, 2012; Squire, 2011). Design thinking is an integral element of these approaches, just as design thinking is promoted in Cooperative Inquiry approaches. This wealth of evidence in the learning sciences begs the question, why limit the approach to game design or physical computing? Why not include learners in the process of designing technologies they are using to learn, as well?

Perhaps one of the obstacles to building more convergent paths across the respective disciplines is related to the paradox of informed participation: individuals cannot really be informed unless they participate; yet they cannot really participate unless they are informed (Eden, 2002). For CSCL research, this challenge is reflected in the question, how can learners actively and effectively design technologies for concepts that they have not yet learned? PD research faces a similar conundrum: in a rapidly evolving, increasingly ubiquitous technological landscape, how can users contribute to ideation and concept development for contexts-in-use that they have not yet experienced? These parallel, but nearly equivalent challenges serve to underscore the potential value of increasing collaboration and cross-pollination across CSCL and HCI.

Complimentary Perspectives: Embedding PD into Designs for Learning

The presentations included in this symposium offer different lenses for considering PD approaches in learning contexts. Our first presentation explores the potential cognitive and social benefits that PD techniques hold for the child designers who engage in them. Our next two presentations review the ways in which PD techniques enhanced collaborative technologies that promote digital literacies (e.g., multimedia, storytelling) and STEM learning. Our fourth presentation addresses the tension between content expertise and design expertise, offering a comparison of PD results from children experienced in design with children learning in STEM environments. Our final presentation explores opportunities and challenges facing CSCL and HCI researchers who seek to include learners with special needs, such as those with autistic spectrum disorder, in the design process.

From a theoretical perspective, our exploratory studies reveal that PD techniques can be both an effective means for improving technology designs, and a valuable resource in DBR frameworks. From a practical perspective, we demonstrate various PD approaches we took that may inform future DBR studies across CSCL and HCI that seek to incorporate PD into their methodologies (e.g., Guha, Druin, & Fails, 2013).

Presentation 1: The Cognitive and Social Experiences of Children Involved in PD

Mona Leigh Guha

Over the past several years, researchers and designers across academia and industry have partnered with children to design new technologies (Gibson, Newall, & Gregor, 2003; Takach & Varnhagen, 2002). While many studies have explored the effects that co-design with children has on the resulting technology, few have investigated the impact of co-design participation on the child designers themselves. Specifically, there has been little documentation on the impact that becoming an equal partner in co-design with adults may have on the participating child designers. Much of the literature regarding children's involvement in technology design includes only incidental mentions of the potential benefits to child design partners. Formal studies focusing on the child design partner's experiences are scarce. My study represents an initial foray into discovering if there are indeed specific social and cognitive experiences available to child design partners (Guha, 2010).

First, I will introduce co-design with children as a set of PD techniques that involve children as equal partners throughout the technology design process, from conception to completion. I will include a discussion of various co-design techniques, including the points during the design process in which they may be used most effectively. Next, I will describe a qualitative case study that explored the social and cognitive experiences of children involved in co-design with adults. The children who participated in the study were members of an intergenerational team of adult researchers and child designers, known collectively as Kidsteam, from the Human-Computer Interaction Lab (HCIL). In this case study, I followed eight child design partners over the course of a year, collecting data such as observational notes and artifacts, as well as interviews with the children and their parents. The data was inductively coded into categories to arrive at a model of the social and cognitive experiences of child design partners. In particular, the child design partners had experiences in the cognitive domain in skills and content, in the social domain in relationships, enjoyment, and confidence, and in the overlapping social and cognitive domains of communication and collaboration (Guha, 2010). I will detail the conceptual framework that describes these social and cognitive experiences of child design partners, and also propose opportunities for future collaborative, interdisciplinary work among HCI and CSCL researchers.

Children across a range of ages, not just 7-11 year olds, can be included successfully in the co-design process. At the HCIL over the past decade, we have found that even very young children (4-5 years old) have life experiences that they can draw upon to contribute to a learning technology design process, given flexible design techniques and equal footing with their adult design partners (Guha et al., 2004). At the other end of the childhood age spectrum, we have also found ways to use co-design with pre-teens (Knudzton et al., 2003) and teenagers (Yip, Foss, & Guha, 2012). Each of these co-design efforts shows promise for their incorporation into the design process for learning technologies as well.

Presentation 2 – Participatory Design, Mobile Storytelling, and New Media Literacies

Elizabeth Bonsignore

I will relate the impact of PD in the development of an online digital library for children, the International Children's Digital Library (ICDL), and a mobile storytelling application (StoryKit). The two projects highlight the ways in which PD processes resulted in collaborative, creative technologies that were highly intuitive and engaging for children. Their intuitive, child-friendly features prompted their international proliferation not only in family/social contexts, but also in a variety of learning contexts.

The ICDL (childrenslibrary.org) is a freely available, online collection of children's literature from around the world. The ICDL collection includes over 4500 books in 61 languages, representing 65 countries. Over 6.5 million children and adults from 228 countries have visited the ICDL since its official launch in November 2002, with an average of 100,000 visitors logged per month. The design goals for the ICDL were to inspire intercultural awareness in children (ages 3-13) by providing broad online access to an international collection of children's literature; to create new technologies that were age appropriate and engaging; and to expand existing PD methods by involving children in the design process (Druin, 2005). The HCIL's Kidsteam engaged in iterative design cycles from 2000-2005, testing the viability of various search/browse/reading interfaces (Druin, 2005; Hutchinson, Druin, & Bederson, 2006). Kidsteam's co-design approaches offered rich insights into how children want to browse and search for books (and information in general), and how they prefer to read digital texts. For example, co-design efforts with Kidsteam confirmed that children prefer to search for books in ways that reflect their physical, image-based features (e.g., colors on the cover) or affective elements (e.g., a "happy" or "sad" book), which resulted in an innovative and popular search interface as well as new metadata categories for library cataloguers to consider (Druin, 2005). I will also share the ways in which the ICDL design has been shown to increase children's motivation to read, expand the variety of books they choose, and support their interest in exploring different cultures (Druin, Weeks, Massey, & Bederson, 2007).

One of the design findings from the ICDL project was that children not only wanted to read beautiful books from around the world; they also wanted to create and share their own stories. Furthermore, they wanted to be able to carry and share their stories with them in the same "mobile" ways that they used print books: in the lap of a grandfather, or on a bus with a friend. StoryKit is a mobile application (app) that enables the creation of multimedia stories on iOS devices. Within StoryKit's integrated interface, children can create original stories, or modify sample ICDL stories, using their own photos, drawings, text, and audio. StoryKit authors can also share their stories with friends and family via the Internet. Like the ICDL, an intergenerational design team of adults and children (ages 7-77) designed StoryKit. Since its launch in the Apple iTunes App Store in September 2009, StoryKit has been used over 2 million times by over 385,000 distinct users in 175 countries and in 40 languages/dialects. I will show how the design features that were implemented as a result of the co-design process with Kidsteam resulted in an intuitive, integrated interface whose use has skyrocketed in classrooms around the world. For example, almost 60% of shared stories have been created in formal education settings (i.e., school). The audio tool that is integrated into StoryKit's interface as a result of Kidsteam design sessions has also proven very effective in supporting children in early primary grades (ages 5-7) by allowing them to tell their stories with confidence orally, even as they are learning to read and write (Bonsignore, Quinn, Druin, & Bederson, in press). Moreover, educators have found that the saving and sharing process, which creates a digital artifact of their primary and elementary level writers' progress in literacy activities (ages 6-8), has also helped them to scaffold their efforts in the art of reflection and revision (Bonsignore et al., in press).

Presentation 3 – Participatory Design and Social Media for STEM Learning

June Ahn

I will describe the role of PD in two projects that explore the development of social media platforms for youths and STEM learning. The two cases will highlight how PD yielded new insights about both 1) the design of more engaging and sociable CSCL platforms, and 2) the learning process of children themselves as it relates to aspects of STEM education. In these projects, children and youths engaged in participatory STEM learning practices as they co-designed technologies with the research team. I argue that PD is not only salient for the actual design of technology tools, but is also a valuable contributor to broader DBR frameworks in the learning sciences. Researchers using PD can not only learn about better design techniques, but also glean insight into the learning processes of children that can then be more tightly integrated into the design process.

The first case, Sci-dentity, is an NSF funded Cyberlearning project that engages urban, inner-city youths in science fiction storytelling using diverse digital media, as a means for enhancing their identification with STEM ideas. A major component of the project is the design of a social media platform (sci-dentity.org) where youths can share, comment on, and remix their stories. We used PD techniques with two groups: the HCIL's Kidsteam and the middle school students who were themselves a part of the program. I will outline how Kidsteam provided deep insight into the learning process required when children attempt the complex activity of writing science-infused narratives. Kidsteam child design partners were particularly insightful about the potential obstacles children face when attempting such a complex literacy practice, and their insights led to the direct design of particular social media features on the Sci-dentity.org site, such as the "Brain," which became a shared repository of science knowledge that authors could use as inspirations for their stories. In our design work with middle school adolescents (tweens), we gained deeper insight into the controversial issue of remix practices. Their concerns about remix directly resulted in the redesign of remix functionality in the social media platform. The students in this project simultaneously learned about remix behavior while actively designing their technological environment in ways that reflected their values. We found that: "Working from a youth perspective allows one to recognize the underlying mechanisms for sharing, credit, and permission, and design these functions in ways that align with the perspective of youths" (Ahn, Subramaniam, et al., 2012, p. 7).

For the second case, I will outline the development of SINQ, a social media platform that leverages features seen in popular sites such as Instagram and Reddit, in ways that promote collaborative learning of Scientific INQuiry (Ahn, Gubbels, et al., 2012). In this project, we embarked on a series of development "sprints" that involved programming work by the research team coupled with co-design sessions with Kidsteam. The design narrative of this experience sheds light on how specific PD techniques in each of the development sprints allowed us to 1) glean insight into how children acquire scientific inquiry skills and dispositions in their everyday thinking, and incorporate these learning processes into the design of SINQ; and 2) observe the ways in which children interact with media, and online communities, in ways that helped us create a more engaging, usable, and sociable CSCL tool. Each of our development sprints could also be conceptualized as cycles of DBR in the learning sciences. Our experience creating SINQ illuminates how children and youths can act as both learners who critically reflect on their STEM learning practices and co-designers who provide direct design recommendations to the developers of the social media platforms used in these projects.

Presentation 4 – Design Expertise and Content Expertise: Complementary Perspectives in the Design of Technologies for Science Learning

Tamara Clegg and Jason Yip

Our project originates from learning sciences research aimed at helping learners to see themselves more scientifically by facilitating their engagement in personally meaningful science experiences. We approached this goal by designing a life-relevant learning (LRL) environment that 1) engages children in science in a context relevant to their everyday lives (cooking) and 2) helps them begin to use science to achieve their own personal goals. This LRL environment, Kitchen Chemistry (KC), engages elementary and middle school children in scientific inquiry through making and perfecting dishes. We draw upon technology to support and scaffold learners' scientific inquiry as they cook.

In previous work, we found that the learning environment helped children begin to engage more deeply in science and to identify themselves scientifically. We also found that the technology we used supported the cognitive aspects of learners' experiences, but not their personally meaningful aspects. Consequently, technology use needed to be prompted and heavily supported by facilitators (Clegg, Gardner, & Kolodner, 2011). To enhance the potential for technologies that are used in LRL environments to contribute to learners' personally meaningful experiences, we have used Cooperative Inquiry-based PD techniques to re-design technology support for LRL. We began these efforts by using StoryKit, a technology that had been designed through Cooperative Inquiry with Kidsteam. We found that learners were highly engaged when they used StoryKit, and that the app supported their scientific inquiry processes (Clegg et al., 2012) and decision-making practices (Yip, Clegg, et al., 2012) quite naturally. We are currently extending StoryKit's affordances to design new mobile technologies that specifically scaffold learners' scientific inquiry in their daily lives. We remain committed to taking PD approaches to address the challenge of engaging learners in the design of learning technologies as they are still learning the concepts and practices the technology is aimed at supporting.

We will also discuss our efforts in addressing this challenge with two different co-design teams whose goal was to re-design early iterations of KC technology. Specifically, we will outline the results from two case studies of design sessions with members from Kidsteam and participants of two different iterations of KC (Yip, Clegg, et al., in press). Kidsteam children are well versed in many co-design techniques and consistently work together with adults each week (Druin, 1999). In contrast, KC children are experts in the learning context and subject domain knowledge. KC learners become specialists in developing food science investigations, integrating cooking and observation techniques, and using technology for collaborative learning. Because we are developing technology for learning environments, it was important for us to design with children who had expertise in co-design and the subtle contextual knowledge of KC. We explored three research questions on co-designing learning technologies with children: 1) What are the affordances and constraints of designing learning technologies with children who have subject expertise; 2) with children who have design expertise? and 3) How can the results of designing with the two groups be combined to inform design practice that involves either group? (Yip et al., in press). We advocate that comparing two sets of co-designers allows for triangulation and insight into complementary design ideas that can be optimized for the design of learning technologies.

Presentation 5 – Enhancing the Social Skills of Children with Autism Spectrum Disorders with Multitouch Applications and Activities, supported by Participatory Design

Juan Pablo Hourcade

Children in the autism spectrum have been gaining a greater amount of attention recently, in great part due to increasing rates of diagnosis (CDC, 2012). Early diagnosis and therapy can make a significant positive difference in improving children's social skills. However, even a majority of those who receive early diagnosis and treatment do not grow up to live independently as adults (Eaves & Ho, 2008; Howlin, Goode, Hutton & Rutter, 2004). This means that in addition to emphasizing early diagnosis, there is a need to develop new interventions that can improve the likelihood that children diagnosed with autism will grow up with the skills necessary to live independently. I will outline my research team's efforts to add to our understanding of interventions that can support this special, under-represented population, highlighting the ways in which PD techniques enhanced our design activities and outcomes.

When the first multi-touch tablets became commercially available in the summer of 2009, we saw an opportunity to provide a novel intervention to children in the autism spectrum. While children in the spectrum vary significantly in their needs and ability, in our experience, most of them have a strong affinity for computers. This may be due to the predictability of computers and the ability to control them, something that does not occur with face-to-face interactions. We saw the potential for multi-touch technologies to provide the ability for children to engage in face-to-face interactions while doing something they enjoy.

As we began to consider how to proceed, we contacted local parent support groups, observed children, and also visited with a local group of adults with Asperger's syndrome. As we engaged with these groups we developed a set of principles that guided our work, which we refer to as APPS: Access, Participation, Personalization, and Sustainability. In terms of access, we emphasized designing and working on technologies that become widely accessible, given the important and immediate needs of the community. We engaged with all stakeholders including the children, their parents, teachers, and special education staff. In terms of personalization, we addressed the high variability in this population by designing several simple, open-ended apps together with activities that could be conducted with them. The combination of apps and activities gave us a lot of flexibility in personalizing what children experienced, and made it more likely we could find an activity and app that could work for a specific set of children (Hourcade, Bullock-Rest, & Hansen, 2012). Finally, to support the sustainability of the project, we made all the code open source and activity guides freely available online (openautismsoftware.org) to ensure others could pick up the project and expand it on their own.

We used a variety of techniques to engage the children in PD activities. Children who could speak without much trouble were able to participate in the same type of activities in which typically developing children participate. If anything, they were less likely to hold back criticism. We had to be more creative with lower-functioning children who spoke little or did not speak at all. To get feedback from them about apps or design ideas, we had to use picture cards, or simply write "yes" and "no" on sticky notes and ask them to point at one of them when asking them whether they liked a particular aspect of an activity or app. We also learned that some of the children really disliked changes in the user interface if they had gotten used to an earlier version. In one case it caused a great deal of frustration in a child, so we recommend that interaction designers in similar situations keep previous versions of apps handy (Hourcade et al., 2012).

We have conducted an evaluation of the impact of the apps and activities on children's behavior, and found in a recent study that children had more verbal and physical interactions when using the apps than when conducting similar activities without apps (Hourcade, Williams, Miller, Huebner, & Liang, 2013). We also found some of the apps led to more supportive comments from children than other apps or activities without apps. Our experiences point to the feasibility and value of engaging all stakeholders including children with autism in PD activities, as well as the positive effects of our particular approach to engaging children in face-to-face activities to improve their social skills.

Significance

The aim of our symposium is to advance the practice of DBR across multiple disciplines through collaborative investigations into PD techniques that enhance the design of learning technologies as well as benefit the learners who participate in their design. The integrative nature of our goal is significant to the conference theme of "learning across levels of space, time, and scale," precisely because it seeks to reduce disciplinary boundaries and amplify commonalities across design methods. Each of the studies detailed here offers a metaphorical grain of sand that, taken together, builds a worldview demonstrating the potential for PD techniques to shape future learner-centered systems. From the outset, CSCL has been an interdisciplinary field. Deepening the dialogue between HCI and CSCL researchers who are using participatory approaches in learning contexts can only serve to strengthen CSCL's interdisciplinary tradition.

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