

# Designing for Learners, *with* Learners: Toward a theory of Cooperative Inquiry in the Design of Learning Technologies

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**Abstract:** In this paper, we explore connections between Participatory Design and Research-through-Design approaches originating from HCI and Design-Based-Research (DBR) and Learner-Centered Design principles from the Learning Sciences (LS). Our focus is on the Participatory Design approach known as Cooperative Inquiry, in which children (typically 7-11 years old) and adults work together as full partners to design technologies intended for use by children. In our experience as members of an interdisciplinary HCI/LS research team, we have found parallels between CI practices in HCI and learner-centered, design-based research paradigms in LS. These commonalities offer pockets of opportunity for advancing a more integrated and mutually generative relationship between our two disciplines. We also touch upon opportunities and challenges that researchers in HCI and LS may face in crafting a complementary research agenda to develop learning interaction design theories that actively involve learners in the process of designing the technologies they themselves will use.

## Motivation

Over the past decade, the rapid evolution of social networks and online communities, along with the technologies that support them, has spurred the development of a Participatory Cultures movement. Participatory Cultures are online and offline social spaces characterized by low barriers to entry and strong support for creating and sharing knowledge (Jenkins et al., 2006). The movement to broaden participation in our technology-infused culture has been propelled and promoted by a wider “do-it-yourself” ethos that is prevalent among youth today (Kafai & Burke, 2013; Knobel & Lankshear, 2010; Williams et al., 2012).

Participation is not just limited to producer-oriented endeavors. Teenagers (12-17 years old) number among the most avid users of social networking sites, online games, and related social media tools (Zickuhr, 2011). Even children under 12 represent a rapidly growing sector of users who engage in these socially mediated technologies (Grimes & Fields, 2012). Furthermore, portable, personalized technologies are ubiquitous in children’s lives – whether at home or at school. In increasing numbers, children (8-18 years old) own smartphones or “feature phones” with media players and cameras, and in several countries, children have a higher rate of smartphone ownership than their parents (Bonsignore, Quinn, et al., 2013). In learning contexts, iPod- and iPad-in-the-classroom initiatives are also expanding (Banister, 2010).

In response to these participatory trends, researchers in the fields of Learning Sciences (LS) and Human-Computer Interaction (HCI) are working to meaningfully map technology use by today’s youth to its potential to support personally relevant and socially situated learning (e.g., Clegg et al., 2012). Running throughout these efforts is an emphasis on crafting design-based opportunities for children to have a voice and choice in how their learning is directed (Ito et al., 2013). Participatory Design (PD) approaches in HCI and LS have enriched the process of designing technologies that support such participatory learning (Ahn, Gubbels, et al., 2012; Barab et al., 2005; Clegg et al., 2012). Designing with youth can also enhance our understanding of the conceptual processes of the learners themselves (e.g., Ahn, Subramanian, et al., 2012) and hold potential to benefit the learners who participate in their design (Guha, 2010).

HCI and LS researchers may be converging on a sweet spot that is ripe for cross-pollination, given the intersection of 1) the burgeoning accessibility of social and mobile technologies that can support authentic, in situ learning, 2) a socio-cultural emphasis on participation, and 3) similarities among Learner-Centered Design and Participatory Design (LCD & PD) theories and practices. In this paper, we examine several junctures at which core methods and principles of HCI might be of use to LS researchers, as well as theoretical foundations that LS might offer to support HCI researchers interested in designing technology to support learning. Our focus is on interdisciplinary efforts that involve children directly in the design process. We believe such initiatives will not only result in creating innovative learning technologies, but can also yield insights into the learning processes of the children who use them.

## Parallels Among HCI and LS Research Theories and Practices

Core HCI methods and principles that already complement LS research include PD (specifically, Cooperative

Inquiry), and the concept of Research through Design (Zimmerman et al., 2007). Similarly, LCD (Soloway et al., 1996) and narrative-driven design-based research (DBR) (Hoadley, 2002) are theories and methods originally derived from LS that can inform HCI researchers who design learning technologies. Here, we examine overlaps in each that may support the future development of more integrated HCI and LS efforts.

### **Complementary Perspectives: Learner-Centered Design and Participatory Design**

Soloway et al. (1996) represents one of the first attempts by LS and HCI researchers to compare notes on natural overlaps between their respective disciplines – and how each could inform the other. Soloway extended user-centered design guidelines from HCI to support users who are also learners by integrating LS theory into the design process. LCD design principles attuned HCI researchers to the differences between designing for learners and designing for users. For example, learners require scaffolds for learning *while* doing, not just designs for optimizing task completion, as experienced users might need.

Likewise, PD approaches in HCI over the past several decades have extended user-centered design philosophies to include end-users as active, vocal participants in the technology design process (Schuler & Namioka, 1993). LCD extended user-centered design by considering the needs of learners younger than the adult professionals who were the original target audience for HCI designers. Similarly, Cooperative Inquiry (CI) adapts and extends PD techniques to include children (7-17 years old) as active participants in the design process. In PD projects that develop technology for young people, children can assume various roles in the design process, from user and tester to informant and full partner (Druin, 2002). In CI, children act as full partners with adult designers throughout the design process (Druin, 1999). In the same way that technologies designed with LCD approaches may support the cognitive development of learners who use them (e.g., Quintana et al. 2004), technologies that have been designed with active involvement from the children who will use them can also improve their sustained engagement, relevance, and usability (e.g., Bonsignore, Ahn, et al., 2013; Druin, 2005). The child-centered core of CI developed in HCI echoes the learner-centered principles developed in LS. HCI and LS researchers would benefit from exploring ways to integrate their complementary focus on younger, still-developing users.

### **Complementary Perspectives: Design-Based Research and Research through Design**

DBR grew from LS researchers' efforts to devise methods that more authentically reflect complex learning environments. The goal of DBR is to “[experiment] with intervention designs in situ, to develop theories of learning” (Sandoval & Bell, 2004, p. 199). DBR is a narrative-driven, iterative process of designing and evaluating learning environments, then feeding practical refinements into future designs and theories (Hoadley, 2002).

In HCI circles, the principles and practices of Research through Design (Zimmerman et al., 2007) essentially mirror DBR processes used in the LS field. In Research through Design, researchers extend the background work conducted as part of the normal system development process by also looking for ways that their design results may contribute to and extend the theoretical HCI knowledge base. For example, what do user interactions with the audio features in a storytelling tool imply about theories of early childhood literacy? Effectively, the design artifacts created by design researchers offer “concrete embodiments of theory” (Zimmerman et al., 2007, p. 498), in addition to technical product advances.

DBR and Research through Design work can integrate CI by inviting children to share in the process of designing the technologies that support their learning. Such initiatives would be a natural extension of participatory learning in particular, and the participatory cultures movement in general. The iterative nature of both DBR and PD approaches can also afford us opportunities to enhance our understanding of learners' conceptual processes (e.g., challenges, motivations, misconceptions, discoveries) as we partner with learners throughout the design process (e.g., Ahn, Subramaniam, et al., 2012; Bonsignore, Ahn, et al., 2013).

### **Synergistic Efforts: Sample Exploratory Studies**

Over the past several years at the University of Maryland's Human-Computer Interaction Lab (HCIL), we have built an interdisciplinary team of learning scientists and HCI designers whose overarching goal is to design and implement effective learning experiences and technologies that closely involve young learners (7-18 years old) in the actual design process. Overall, we have adopted the complementary philosophies of DBR and Research through Design to integrate CI approaches in our efforts to design learner-centered technologies (Bonsignore, Ahn, et al., 2013; Yip, Bonsignore, et al., 2013).

We have explored the development of social media platforms that support Science, Technology, Engineering, & Math (STEM) learning of youth (12-14 years old) through the complementary use of CI and iterative, DBR-based interventions, evaluations and redesigns (Ahn, Gubbels, et al., 2012; Ahn, Subramaniam, et al., 2012). We have investigated the ways in which content expertise and design expertise affect the design ideas and PD process that child designers engage in (Yip, Clegg, et al., 2013). We have used CI to iteratively design a mobile storytelling application that enjoys a global user base, most of whom work in K-12 contexts to

promote literacy learning (Bonsignore, Quinn et al., 2013). We have found evidence of the potential for children to experience social and cognitive benefits from their participation in intergenerational CI teams, which may inform future LS theories and methods (Guha, 2010). We have seen that young designers can be *more* than active *participants* in the design process – they can also *lead* their intergenerational CI teams (Yip, Foss, et al., 2013). Our goal in the workshop is to share and compare our findings with like-minded HCI/LS colleagues in an effort to develop theories and design practices that integrate research strands from both HCI and LS.

### **Challenges and Opportunities: Toward an Integrated HCI/LS (or LS/HCI) Agenda**

We sense a convergence of socio-cultural and technical factors that support efforts by HCI/LS researchers to share principles and practices, and work toward a more integrated research canon. For example, the Participatory Cultures movement has expanded rapidly due to the wide availability of inexpensive, low-barrier-to-entry, and open-source technologies and a growing community of makers who provide peer-to-peer mentoring and support. This socio-cultural environment resonates with the user- and learner-inclusive trajectories of CI and LCD studies. From a technical perspective, communications interaction and infrastructure tools are now available to collect, analyze, and share learner connections and activities, from both mobile and static computing environments, “in the wild” (Rogers, 2011). The same portable and pervasive technologies that learners use to share their own activities can also provide HCI and LS researchers with the means to capture user interactions in more authentic, in situ contexts than traditional lab settings, often on a much larger scale (Ahn et al., 2013; Bonsignore, Quinn, et al., 2013; McMillan et al., 2010). These technological advances not only help improve design methods, they can increase HCI and LS researchers’ ability to conduct DBR iterations more effectively.

One challenge in 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). Informed participation is a form of PD in which individuals who are not experts “transcend beyond information known or given to incrementally acquire ownership in problems and contribute actively to their solutions” (p. 378, Fischer & Ostwald, 2002). For LS research, this challenge is reflected in the question, how can learners actively and effectively design technologies for concepts that they have not yet learned? CI research in HCI faces a similar conundrum: in a rapidly evolving, increasingly ubiquitous technological landscape, how can young 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 LS and HCI.

The time is ripe for designing technologies for learners, *with* learners. We espouse learner-inclusive, DBR design approaches that involve children as full partners. We have initiated several projects that are exploring best practices and opportunities for exploring such multidisciplinary intersections, and hope to use the workshop as a means for improving and extending these early efforts. We envision that such partnerships will not only result in the creation of novel learning technologies, but also can yield new insights about the ways in which children conceptualize and reflect upon the learning that those evolving technologies promote. We look forward to the opportunity for cross-fertilization of our efforts.

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