Cooperative Inquiry in Designing Technology in Life-Relevant Learning for Science

Jason C. Yip, Tamara Lynnette Clegg, Allison J. Druin, Mona Leigh Guha, Evan Golub, Elizabeth Bonsignore, Elizabeth Foss, and Greg Walsh
University of Maryland – College Park, Human-Computer Interaction Lab
2117 Hornbake Bldg, South Wing, College Park, MD 20742
Email: {jasonyip, tclegg, allisond, mona, egolub, ebonsign, efoss, gwalsh}@umd.edu

Abstract: In this presentation, we offer an approach to designing supporting technologies for science learning in everyday informal contexts. We advocate for Cooperative Inquiry as a means of engaging learners in the development and design of their learning activities and supporting tools. Our participatory design approach focuses on actively engaging researchers and children in setting design goals, planning prototypes, and making decisions, ensuring the final design meets the needs of the end users. We outline the results from two case studies of design sessions with members from a design team (Kidsteam) and participants of a summer science program (Kitchen Chemistry). We present the methodological steps we adopted to co-designing early prototypes, what features learners find important in the technology for their personal interests, and what implications can be made for designing technology for everyday learning.

Introduction

National goals emphasize “science for all” (e.g., AAAS, 1990). However, science can often be presented as abstract facts that are disconnected from learners’ daily lives. Subsequently, studies indicate that many learners can be turned off from this form of science learning (e.g., Atwater, 1996). One approach to addressing this challenge is to help learners engage in scientific practice in the context of their own personal interests. Therefore, we aim to design learning environments called *life-relevant learning* (LRL). We define LRL as engaging learners in science through the pursuit of their own meaningful goals. Our LRL environment, *Kitchen Chemistry* (KC), is an out-of-school program where participants engage in scientific practice in the everyday context of cooking. In this LRL environment, we have found that learners engage scientifically in new ways (Chinn & Malhotra, 2002) that promote their scientific identity development (e.g., Clegg, Gardner, & Kolodner, 2010) and informed decision-making practices (Yip et al., 2012).

While technology can help address the challenges learners face in LRL environments, these tools also need to support science learning in the context of learners’ own personal interests. We contend that in order to design LRL technologies that promote scientifically meaningful experiences in everyday contexts, we need to capitalize on learners’ personal goals. Therefore, we advocate for *Cooperative Inquiry* (CI) as a means of engaging learners in the development of the supporting tools (e.g., Druin et al., 2001). CI is a participatory design approach created for designing technology for children with children. Our CI approach focuses on actively engaging researchers and children in setting design goals, planning prototypes, and making decisions to ensure the final design meets the needs of the end users. While CI provides a way for developing user-centered technology, few studies have focused on co-designing with children to develop technological tools to help make science learning more personal. For this study, we aim to better understand two questions: (1) how can technology be better designed to meet participants’ learning and practical needs in LRL experiences? and (2) how can we structure the CI process for designing technology for LRL experiences?

Methods

To answer these questions, we worked with two different groups of children and adults. The first group was composed of the eight children (four boys, four girls, ages 7–11) and researchers of *Kidsteam*, an out-of-school program at the University of Maryland’s Human-Computer Interaction Lab. Throughout the year, the team develops, evaluates, and co-designs new technologies for children. We chose the Kidsteam members because they have more CI design experience. The second group was composed of seven children (three boys, four girls, ages 9–13) and adults that participated in the

KC program. In 2011, KC was enacted as an all day, one-week summer program. At the end of KC, we asked the participants to engage in CI to develop new technologies for future versions KC. In comparison to Kidsteam, the KC designers did not have as much CI design experience. However, the KC participants had more experience completing the LRL activities.

In these sessions, we employed a low-tech prototyping technique called "Bags of Stuff" (Druin et al., 2001) (Figure 1). In this technique, the children and adults were split into different groups, with each group having one to two child partners and at least one adult. Each group was asked to create models of new technologies using pre-determined art supplies found in large bags. During the design time, we took field notes, photos and recorded the session on video. Once these models were created, the child-adult groups came together again in a whole discussion group to present their designs. As the groups presented to the full team, we wrote on a large whiteboard "the big ideas" that were present, recording the ideas that were the most repeated among the groups and received the most attention from the whole group. From these low-tech prototypes and presentations, we used a constant comparative analysis (Strauss & Corbin, 2007) and observed emergent patterns that we interpreted as important in designing technology for LRL environments.

Figure 1. **Low-tech prototyping. Children and adult partners work together using a technique called "Bags of Stuff" to develop ideas for future technologies.**

Findings
From the Kidsteam session, we found five main themes within the artifacts. First, our Kidsteam partners focused on familiar interfaces, such as iPads™ and iPhones™. Similar to these commercial devices, the Kidsteam partners wanted capture their experiences in photos and videos to share and reflect. Second, Kidsteam emphasized mobility. They wanted tools that could easily interact within the context of any cooking science investigation. Third, the Kidsteam partners emphasized that displays that showed processes over time in cooking. Fourth, we found was that learners asked for devices that helped scaffold the cooking investigations. Fifth, the technology needs to have sensors that help learners detect different properties about their foods.

In the KC design session, all of the same five themes from Kidsteam manifested in the prototype designs. Interestingly, the prototypes of the KC partners also reflected four more themes. First, KC learners wanted to retrieve information *in situ* about the foods they were working with. Second, online social communities were a priority. Learners wanted to communicate with other Kitchen Chemists and friends. Third, KC designers put in games and earning points into their prototypes. Fourth, KC designers wanted an unobtrusive way for the technology to help them conduct their investigations. We observed that many times learners would spill food and drop the iPads™ used in KC.

Implications
Our work with CI extends the argument that built-in science scaffolds, such as prompts and visualizations, may need to be integrated more seamlessly within multiple contexts. For example, how can technology support learners to ask informed questions on their everyday observations? We argue from our data that flexibility is needed. These sessions allowed us conceptualize how to think about

social community, mobility, usability, and narratives as ways that are already familiar. We call for the development of technology that not only enables learners to access, share, and extend their life-relevant scientific experiences across the contexts of their lives, but also for technology that integrates to how learners already naturally interact, perceive, and interpret everyday phenomena (Clegg et al., 2012).

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