SINQ: Designing Social Media to Foster Everyday Scientific Inquiry for Children

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ABSTRACT

In this paper, we describe a mobile, social media app called SINQ that was the product of a 15-month co-design process with a child design team. The goal of SINQ is to utilize social media design features in ways that help children conceptualize Scientific INQuiry practices through intuitive sharing of media and ideas from their everyday lives. We describe how SINQ builds from prior work in software for science learning and mobile technology for children. We also highlight how SINQ is a distinct evolution of technology for scientific inquiry learning. We argue that by taking seriously, the affordances of social media applications, new opportunities and design challenges arise for interaction design for learning technologies.

Categories and Subject Descriptors

H5.m [Information interfaces and Presentation (e.g., HCI)]: Miscellaneous.

General Terms

Design, Human Factors.

Keywords

Children, Social Media, Science Learning, Participatory Design, Cooperative Inquiry.

1. INTRODUCTION

Janine is a 9-year old girl in Atlanta, GA who is participating in an after-school cooking class. She and her friends are making brownies and she wonders "how could I make my brownies more moist?" Janine's class is using an app called SINQ. She opens the app on her iPad and snaps a picture of her dry brownies and poses this question. She also adds a "cause and effect" to her question, hypothesizing that adding more water would make her brownies moister.

Gregory is an 8-year old boy in Washington, DC. He loves doing projects at home and has recently found an iPad app called SINQ where other children pose questions and project ideas to test them. He comes across Janine's post about brownies, and he asks his mom what she thinks about the question. His mom suggests that adding different amounts of eggs might affect the moistness of a brownie. Together they add an alternative "cause and effect" with a hypothesis about eggs. They also add an "investigation" that outlines a step-by-step brownie recipe, where the only ingredient that changes is adding 1, 2, or 3 eggs.

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Back in Atlanta, Janine sees that someone else has attached a cause and effect and investigation to her original question. She likes the idea of eggs, so in her cooking class, she and her friends try out 3 different brownie recipes with 1, 2, or 3 eggs. Gregory and his mom also try out some brownie recipes at home and test out their egg hypothesis. What is the answer?

This vignette describes a use-case and vision for our work to design and develop SINQ, an iPad social media app to foster everyday scientific inquiry for children. In the following paper, we first describe the design and functionality of SINQ. We delineate how our design process developed from prior work in software for science learning and mobile technologies for children. We also outline how SINQ is an evolutionary step in thinking about the design of mobile, social media for children's everyday learning. We argue that by taking seriously, the ways in which popular social media applications shape human interaction, interesting opportunities and challenges arise for interaction design for learning.

2. WHAT IS SINQ?

SINQ (for Scientific INQuiry) is a mobile application for the Apple iPad platform. The app was developed iteratively over 15 months and co-designed with a team of child designers. Our goal in developing SINQ is to create a social media application that allows children to engage in cognitive and hands-on experiences for learning scientific inquiry skills (*e.g.,* questioning, hypothesizing, experimenting etc.) in the context of their own lives and personal interests. Therefore, we designed SINQ to be flexible enough to allow children to capture the spontaneous thoughts that arise organically from everyday experiences *and* to be structured enough to guide children through a basic operationalized model of scientific inquiry focused on questions, causes and effects, and step-by-step investigations.

Considering the interactive experience from a child's perspective was a crucial component of our design process. Throughout our design process, we had to integrate learning theories concerning scientific inquiry with many iterations of co-design with children. This process gave us insight concerning the opportunities for *interaction design* for this type of learning. Thus, we used various design paradigms including (a) learner-centered design [12] to determine a model of scientific inquiry and what types of scaffolding would be required to help children learn about inquiry, (b) participatory design with children [8], and (c) design-based research [7] to implement SINQ with children within informal learning settings.

The initial prototype of SINQ focused on how to design social media to promote a given model of scientific inquiry. Thus, the application was browser-based (e.g. accessed through a standard web-browser via laptop or computer) and the primary mode of interaction was textual. Learners in SINQ entered questions, hypotheses, and project ideas to the social media platform, and the

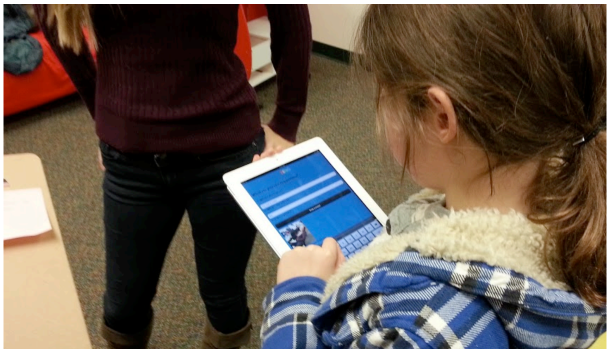

Figure 1. Child using SINQ on an iPad.

system aggregated these micro-contributions into coherent science projects that children could then attempt [1]. However, through multiple iterations of co-design with a child design team, SINQ evolved into a mobile, iPad app where the primary interaction was through visual contributions.

2.1 What Does SINQ Do?

When a child opens SINQ, they see an interface that consists of (1) options to create a *new* question, cause and effect, or investigation, and (2) a grid layout of these elements of scientific inquiry that other children have created previously (Figure 2). Children can start an inquiry process by creating a new question, cause and effect, or investigation. By developing SINQ as a mobile application, we envision children being able to quickly snap a photo and capture a thought of something that piques their interest as they go about their everyday life. The interaction design is aimed at helping children think about their everyday lives through the lens of inquiry. As they have experiences each day, our vision is for children to capture their lives in the forms of questions (e.g. what do I wonder about?), causes and effects (e.g. how does it work?), and investigations (e.g. how could I explore this?).

We have designed unique widgets for creating each of these inquiry actions. The widgets scaffold different parts of the inquiry process, which researchers have highlighted as an enduring need

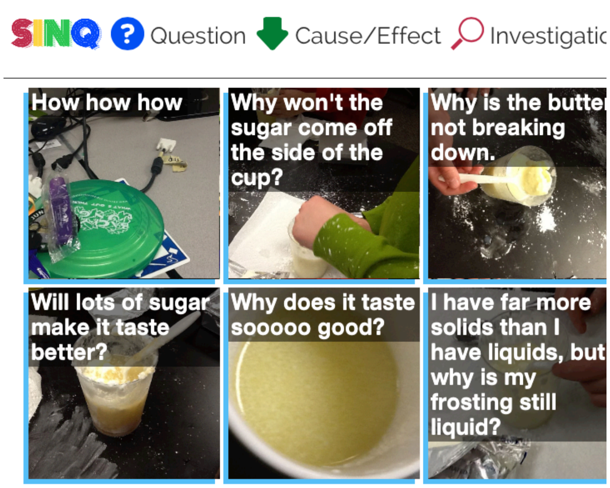

Figure 2. The default user interface. It shows the entry points for creating a new contributions and existing contributions.

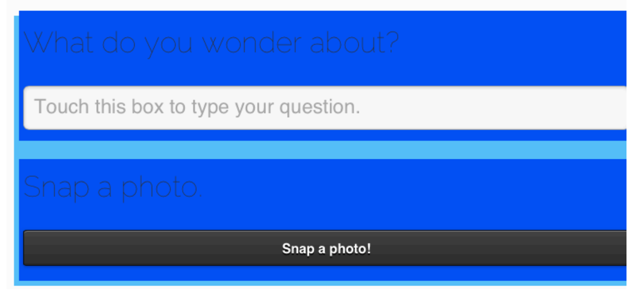

Figure 3. User interface for creating a question.

during the learning process [11]. The interface guides children through asking a question, observing a cause and effect, and developing steps for an investigation (e.g. Figure 3, 4, 5).

These widgets contain textual prompts in the form of questions designed to gently guide children to reflect on aspects of their thought. For example, the widget that supports entering causes and effects prompts, “What do you notice?” This elicits an account of an observed phenomenon, or one component of a *cause and effect*—the effect. Widgets also have visual designs that illustrate information about the conceptual model of a thought process. For example, Figure 4 shows the widget for creating a cause and effect. A child enters what they noticed, why they think this phenomena occurred and then is invited to “Snap a photo!” to share their observation with the SINQ community. The green arrow illustrates a conceptual relationship between *cause* and *effect*.

In our co-design sessions and implementations of SINQ with an after-school cooking program [6], we have observed children responding to the scaffolding in widgets and riffing on existing contributions. For example, during a baking session, one child decided to ask, “Why is the butter not breaking down?” The question becomes available for all children using SINQ and when they tap on the question, the widget prompts them to add causes and effects or investigations to the question.

While experimenting with making frosting, another child added a cause and effect based on his experience doing so. He noticed that his frosting was “soupy” after adding lemon juice to the mixture. He happened to see the question about butter and believed his cause and effect was related to the question. He selected the

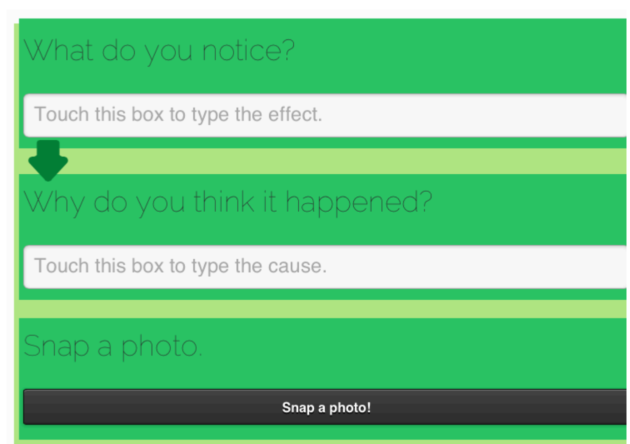

Figure 4: User interface for creating a cause and effect.

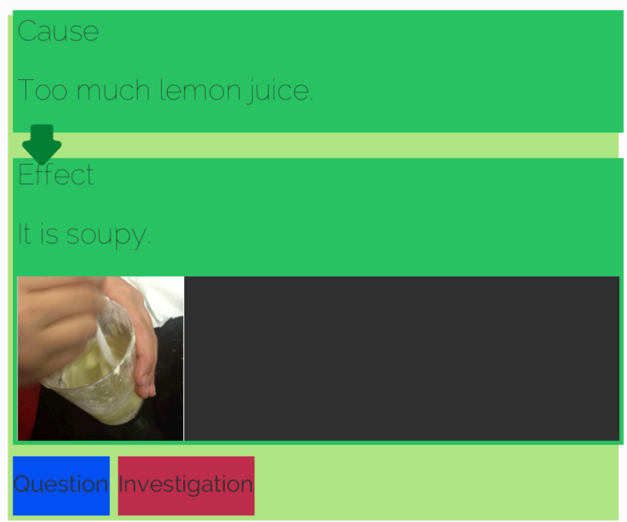

Figure 5. Interface widget for the cause "Too much lemon juice." and effect "It is soupy".

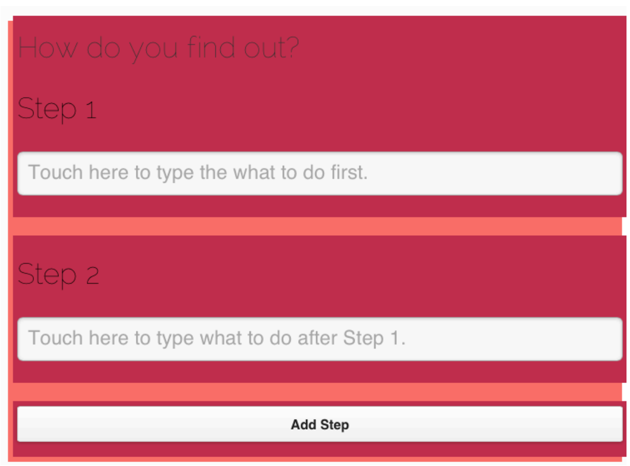

Figure 6. User interface for creating an investigation showing only a prompt for the first step.

question and tried to add his cause and effect. SINQ responds by presenting the interface shown in Figure 4. He adds the cause "Too much lemon juice" and the effect "It is soupy" (Figure 5).

In a similar way, another child might see an interface for creating an investigation to answer this question of what happens when mixing butter with different substances (Figure 6). SINQ prompts children to develop step-by-step investigations to answer the question "how do I find out?" about a given question or hypothesis (Figure 7). The app is designed such that children can work through individual widgets, add onto others' already existing contributions, and contribute frequently about everyday life observations. The system aggregates these contributions into coherent projects and we hope that in the process, models for children how they can directly design and contribute skills such as questioning, hypothesizing, and investigating.

2.2 What Problem is SINQ Designed to Address?

Many learners are disenfranchised with science and a gap exists between formal school science and the lives of students outside of

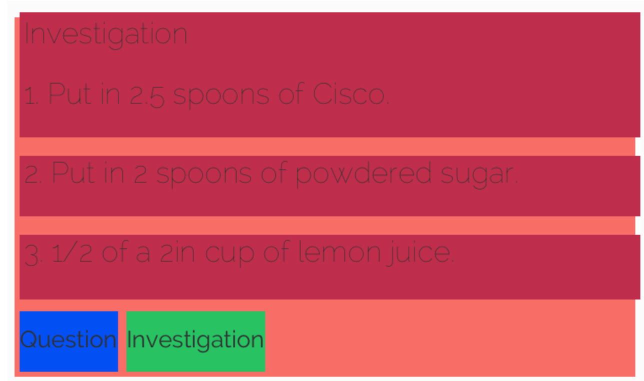

Figure 7. Interface widget for an investigation consisting of three steps: (1) "Put in 2.5 spoons of Cisco", (2) "Put in 2 spoons of powdered sugar", and (3) "1/2 of a 2in cup of lemon juice."

school [2]. Learners perceive science learning to be abstract and meaningless to their everyday lives. To bridge this disconnect between formal classroom science learning, many researchers have undertaken the challenge of building science inquiry learning into informal settings, such as museum learning [3] and afterschool programs [5]. Informal environments can create fun, enjoyable experiences where children can practice scientific dispositions in ways that relate to their everyday lives.

Despite the perceived fun in informal settings, science inquiry is hard to learn and direct. We know from prior work that children and novices need a substantial amount of scaffolding to learn scientific inquiry [11]. In particular, social collaboration and peer learning in science inquiry also requires cognitive support in order to help reduce load and increase beneficial reflection and interpretation [13]. Ironically, classroom science learning, with its heavy scaffolded design, leads us back to the same issue of science learning being abstract and devoid of real world integrity and meaning. Clegg and colleagues [5] challenged the IDC community to develop technology that is designed to allow learners to connect their own interests and life experiences to scientific inquiry, while preserving a level of scaffolding to help them develop strong inquiry practices and mental model. Similarly, we are designing SINQ with these two principles. First, scaffolding must be put in place to support science learning and social collaborations (the interface and widgets). Second, technology must be adaptive and flexible enough for learners to integrate science inquiry into their everyday lives and contexts (interaction design afforded by mobile devices and social media).

2.3 Prior Technologies for Science Learning and Social Collaboration in Children

In some ways, our research team and design process has sought to integrate work in the learning sciences that has focused on cognitive support of science inquiry with research in the IDC community that provides insights into children and their interaction with mobile devices.

Much work in the learning sciences as focused on cognitive scaffolding in software. For example, the Web-based Science Inquiry Environment (WISE) uses collaborative tools and scaffolds—such as online discussions, peer review, and debates—to help students communicate and work together to build ideas and understanding around science phenomenon [10]. While prompts and scaffolds in WISE are important features to support learners in peer science learning, WISE is not designed for learners' everyday observations and interactions. Instead, WISE is developed mainly for teachers to flexibly adapt and integrate a library of existing projects into their curriculum. The Computer Supported Intentional Learning Environments (CSILE) focuses on knowledge building through collaboration [13]. CSILE also uses scaffolds and prompts to guide learners to build conceptual theories, develop constructive criticisms, clarify problem statements, and summarize what they have learned. What CSILE is not designed for is mobile interactions across different everyday contexts. Little research has been conducted on the possibility of knowledge building tools for everyday learning environments.

Conversely, we were also inspired by past research in the IDC community that has illuminated the affordances of mobile technology for children [9]. Mobile tools allow children to create artifacts in diverse settings, beyond the walls of a classroom. However, many mobile tools themselves are situated in specific informal learning environments, just as tools developed in the learning sciences often focus on classroom learning. For example, Tangible Flags [4] are designed to support and encourage children to collaborate on digital artifacts when they are engaged in a field trip setting. Tangible Flags are designed specifically for a particular open environment, such as a national park or a summer camp. The collaboration that occurs stays only with the flags that are setup in these specific environments. Zydeco [3] attempts to build bridges between informal learning (e.g., museums) with formal learning in classrooms. The goal of Zydeco is to scaffold science inquiry in mobile contexts and to allow learners to collaborate together in argument development. While Zydeco provides both scaffolded collaborative tools and mobility to bridge formal and informal learning, Clegg and colleagues [5] found that learners using Zydeco wanted a way to view and present their data sequentially in a story-like fashion. SINQ is related to these prior examples of mobile technologies for children, and attempts to leverage mobile and social media affordances to (a) allow children to capture their life experiences across general contexts and (b) by contributing to SINQ, view their experiences through a lens of inquiry.

3. Affordances and New Design Opportunities for Social Media

We suggest that mobile, social media platforms afford new ways to blend scaffolded scientific inquiry learning with the natural, everyday interactions children have with technology. We undertook at 15-month co-design process with children to develop SINQ to test this idea, as a form of design-based research. In the process, we have learned that by taking seriously the design patterns of social media and the modalities of mobile technology, new opportunities for interaction design emerge that could enhance learning processes for children. The everyday, social information sharing seen in popular social media apps highlight how individuals are motivated to share their life experiences. Mechanisms such as photo sharing, media sharing, and social feedback (e.g. likes, votes etc.) also shed light on how these social media communities help scaffold members. Prior work in the IDC community illuminates how mobile technologies open up the possibilities for children to participate and reflect on their world.

We integrate these insights in SINQ, where children are guided to share their everyday life experiences through mobile devices, but are equally scaffolded to view these experiences through the lens of scientific inquiry. Future research is still needed to deeply examine the design of social media tools to support learning. Interesting avenues include the need to examine what features of social media can motivate learners to make relevant contributions for science learning from their everyday lives. Designers will also have to account for what scaffolds can support social collaboration for science learning beyond the walls of a classroom. We believe that SINQ is the first step in this line of research.

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