

# Scientific INquiry (SINQ): Social Media for Everyday Science Learning

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## Abstract

In this paper we describe SINQ, a prototype mobile social media (SM) application that utilizes social participation to guide learners through an everyday **Scientific IN**quiry process. The paper outlines the motivation for SINQ based on learning theories of scientific inquiry, the challenges associated with scientific inquiry learning within everyday settings, the design of SINQ to promote science inquiry, and the implications for design and learning with social media that we learned from this development experience.

*Keywords:* science inquiry, informal learning, social media, scaffolding, natural inquiry

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## Introduction

The idea of “Science for All” outlines a set of essential thinking skills for citizens of the 21st century (e.g., AAAS, 1990). Opportunities for science are all around us and there are ripe opportunities to learn science in everyday life contexts. Moreover, researchers find that science learning in formal schools is often irrelevant and disconnected from learners’ everyday lives (e.g., Basu & Barton, 2007). This gap between real-world contexts and science learning is a major problem that has negative cognitive and affective implications for learners. In order to bridge this gap between formal classrooms and everyday contexts, researchers have undertaken ways to build science inquiry into informal settings, such as museums (Cahill et al., 2011) and afterschool programs (Clegg, Gardner, & Kolodner, 2010). Despite the “fun” experiences that informal settings can provide, science learning is quite complex and requires some of the structured processes found in the formal classroom (Kirschner, Sweller, & Clark, 2006). How do we bridge the structured science learning of classrooms with the engaging experiences children have in everyday life? We believe that social media technologies (SM) can support the ability for learners to engage in *natural* inquiry as it occurs in everyday life, while also developing formal scientific skill sets through the exploration of personal interests. In this paper, we describe our efforts to develop SINQ (for **Scientific IN**quiry), a prototype mobile application to support collaborative scientific inquiry activities. We introduce the theoretical framework that underlies SINQ, the design features of SINQ, and the implications of fostering everyday science learning through SM.

## Background

Learners come to any learning situation with productive intellectual resources from their everyday experiences that are compatible with scientific thinking (e.g., Hammer & Elby, 2002). For instance, Basu and Barton (2007) observe that learners have “funds of knowledge”, such as lived experiences, cultural practices, and information that is powerful and can set them up to engage in science. One design challenge is figuring out how to leverage new technologies to help individuals use their everyday knowledge to engage with scientific inquiry. Science inquiry practices take the form of

constructing explanations, assessing available sources of information to inform one's observations, testing hypotheses, and interpreting data or results (NRC, 2000). These practices can be seen in formal, science activities in classrooms (e.g. structured lab experiments), but they are also practices that can provide value in everyday life. For example, whenever someone wonders why the sky is blue or notices that their use of ingredients in their brownie recipe changed its taste, opportunities for inquiry arise that can be lost.

We believe that social media can capture these opportunities to foster lifelong learning in everyday science inquiry processes. SM is a natural way to ask questions and crowdsource information. For example, search engines such as SOCL ([www.so.cl](http://www.so.cl)) utilize social searches and questioning through Facebook™. In addition, social media is accessible and is broadly used across different populations. Increasingly, children (under the age of 13) are becoming major users of social media communities (Grimes & Fields, 2012). Our project begins to address the need for design-based studies that can better understand the design of social media for children's learning.

### What is SINQ?

We developed SINQ as a mobile social media application that fosters peer-based science learning across different contexts (Ahn, Gubbels, Kim, & Wu, 2012). In SINQ, multiple learners can contribute smaller pieces of the inquiry process and attach them to others (e.g. questions, hypotheses, project ideas). The system aggregates these contributions into coherent science projects that children can pursue on their own or with friends. SM platforms can be deeply engaging for young people as they build social capital, share personal aspects of their daily lives, and show off their interests through creative means (e.g., Greenhow & Robelia, 2009). However, based on relevant learning theories, engaging in independent inquiry is complex and cognitively taxing (Kirschner et al., 2006). Learners need structure in the process of developing a good scientific question, creating feasible hypotheses for experimentation, and setting up an investigation (Quintana et al., 2004). In our prior work, we designed a basic prototype that could provide scaffolding of inquiry processes through a browser-based social media platform (Ahn et al., 2012). However, through our subsequent work with children we found that learners also need technologies that fit naturally into their daily lives and make science learning personally meaningful (Clegg et al., 2012). Therefore, in this iteration, we have designed SINQ to be specifically mobile. This focus on mobility can encourage learners to use SINQ in their natural inquiry as it occurs in everyday life, while at the same time, helping to scaffold scientific inquiry skills as they explore their own personal and unique interests. This specific iteration of SINQ also focuses on further developing an interface and integrated media tools through co-design with children (Druin, 2002).

SINQ is designed to foster social, collaborative science inquiry in four ways. First SINQ is designed to help learners capture personally meaningful elements of the inquiry process through their everyday interactions with the world. Similar to Pinterest™ we developed SINQ as a way to post questions and capture learners' daily on-the-go interactions with the world (Cahill et al., 2011). Instead of developing science questions, hypotheses, and investigations in inauthentic settings (e.g., classrooms), SINQ allows learners to enter an inquiry at the moment of inspiration. SINQ allows learners to capture photos of their interest, ask questions or develop a hypothesis based on what is recorded, and post the response to their networks. For example, a child named Alex might come across an observation in which butter does not dissolve in water in his kitchen. Alex uses SINQ on his mobile device to snap a picture of the butter and post his question, "why is the butter not breaking down in water?"

Second, SINQ allows learners to make small and incremental contributions that help to scaffold the process of scientific inquiry. These small contributions from multiple members are then aggregated into coherent science projects. We designed SINQ so that learners can enter into the science inquiry process at any point through contributions of questions, hypotheses, or investigation ideas to match the fluid nature of scientific inquiry. Lastly, the system guides learners through the entire process regardless of where they start. For instance, another child, Barbara, wants to first post a hypothesis about making cake frosting. SINQ prompts her to answer, "what do you notice?" She writes, "my frosting is thicker". SINQ prompts again, "why do you think it happened?" Barbara thinks and writes, "because it got cooler."

Third, SINQ provides ways in which learners can participate in social vetting processes through reflection prompts. SM tools, such as Facebook™ and YouTube™ have various voting mechanisms. However, beyond simple voting we believe that the reflection process is crucial for effective learning (Cahill et al., 2011) and is an important aspect in scaffolding in learning tools (e.g., Quintana et al., 2004). Therefore, SINQ is designed with prompts to promote reflections and elicit participation. Another child,

Charlotte sees Alex's question on SINQ. She wants to vote on it. When she votes, she answers prompts that include, "Is this a novel question?" or "Was this resource helpful to you?"

Lastly, public projects in SINQ allow for more collaborative engagement to be built in science learning. Learners' contributions of questions, hypotheses, and investigations are posted and are socially vetted. For instance, Daisy sees Alex's question and wants to post a hypothesis about the butter observation. She adds the hypothesis, "no stirring means no breaking down." Eli chooses to write up an investigation on stirring, dissolving, and butter and posts it onto SINQ. From these responses, we are further exploring techniques for aggregating and visualizing social and contribution behaviors as a basis for providing additional scaffolding and to help learners form collaborative connections.

## Recommendations for Design and Learning for SM Tools

Based on our experience designing and implementing SINQ we offer the following recommendations for designing social media for fostering informal learning.

### Design recommendations

*Use interdisciplinary design.* The challenge of building a social media platform for science learning in everyday life requires collaboration across disciplines. To understand the problem of science learning, we needed knowledge of the current problems in science education and how to approach science learning through frameworks of cognition and the learning sciences. From a computer supported collaborative learning perspective, we needed knowledge of how people approach learning in distributed ways. Finally, to build the SINQ platform, we integrated our knowledge from human-computer interaction, computer science, and information sciences. Approaching this problem from a number of perspectives allowed us to see the challenge of SM learning in science and how to tackle the issue efficiently.

*Co-design with children.* Our belief is that SINQ should be a social media tool that allows learners to contribute questions that inspire them from their everyday experiences. Using SINQ must feel natural, simple, and easy. Therefore, in order to better understand what learners would want in SINQ, we co-designed the technology with child partners at the University of Maryland's Human-Computer Interaction Lab. Using Cooperative Inquiry (Druin, 2002) we worked together with children (ages 7–11) to design SINQ in a way that would be usable and feasible in an everyday setting. We asked children to develop low-tech prototypes of SINQ and how they wanted to pose questions and hypotheses. Our design sessions with the children gave us insights into how to build an interface that is both structured enough to scaffold science yet inviting to children, including interface design suggestions, how to elicit meaningful science questions through natural interactions, and how to design the voting mechanisms.

*Developing with a learning environment.* We also worked with an informal science education program called Kitchen Chemistry (KC) (Clegg et al., 2010). In KC, children engage in the design of their own food investigations to learn more about the science inquiry process. We have observed in KC that when learners made contributions to SINQ and searched through the contributions of others, they could 1) find other learners with similar inquiry interests, 2) help each other through suggestions and refinements, and 3) develop new questions, hypotheses, and investigations based on other postings. These qualitative findings helped us confirm the efficacy of using social media in the context of scientific inquiry (Clegg et al., submitted).

### Everyday learning and Social Media recommendations

*Strive for natural and mobile interaction design.* Science inquiry in everyday settings means that social media tools need to allow learners to make contributions quickly, simply, and ubiquitously from learners' interactions in their natural environment. For SM to become prevalent in everyday learning in informal environments, the tools must be able cross borders between home and school. In our prior work, we developed a system that was primarily browser-based (Ahn et al., 2012). However, in our subsequent co-design work with children, we quickly found that this mode of interaction was not natural or engaging for a child population. The children co-designers provided us with deeper insights and experiences about the importance of mobile and ubiquitous modes of learning with technology.

*Distribute complex inquiry processes.* Science inquiry processes are challenging and complex. We believe social media can distribute the cognitive demands of science inquiry so that learners can

engage in science practices more easily. Science inquiry is a social process; no single person can truly understand the entire inquiry process in isolation. Evidence-explanation frameworks of science inquiry call for more conversations and examinations of dialectical exchanges between observations, data, and theory. Duschl (2008) observes that such conversations include argumentation, debates, modeling, drawing, writing, and other forms of communication. Through social media children across or within settings can select data for evidence, make claims about evidence, create propositions, and evaluate explanations. Therefore, we suggest that the small contributions of each individual can be assembled to create a crowdsourced inquiry process that allows learners to engage in science on their own personal terms.

*Provide natural scaffolding through SM feedback mechanisms.* Social vetting such as voting and ratings can act as natural scaffolds to help participants learn what makes a good question, a testable hypothesis, or a feasible experiment. We found that guidance from a teacher or facilitator is helpful, but that learners own social interactions in SINQ allowed for more genuine collaborations and refinements. Through learners' own reflections and examination of other contributions, we believe learners are able to develop their own collective strategies to engage in science inquiry.

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