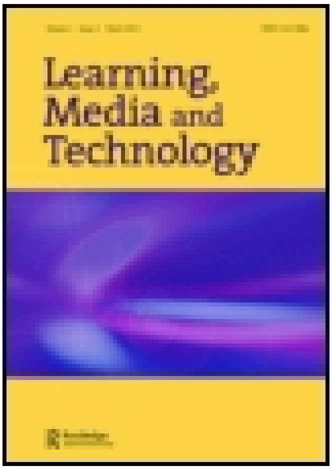

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Seeing the unseen learner: designing and using social media to recognize children's science dispositions in action

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Seeing the unseen learner: designing and using social media to recognize children's science dispositions in action

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This paper describes the development of *ScienceKit*, a mobile, social media application to promote children's scientific inquiry. We deployed *ScienceKit* in *Kitchen Chemistry* (*KC*), an informal science program where children learn about scientific inquiry through cooking. By iteratively integrating design and implementation, this study highlights the affordances of social media that facilitate children's trajectories of disposition development in science learning. We illuminate how the technological and curricular design decisions made in *ScienceKit* and *KC* constrain or expand the types of data we can collect and the actionable insights about learning we can recognize as both educators and researchers. This study offers suggestions for how information gleaned from social media tools can be employed to strengthen our understanding of *learning in practice*, and help educators better recognize the rich actions that learners undertake, which may be easily overlooked in face-to-face situations.

Keywords: social media; science dispositions; data-informed instruction

Introduction

Social media applications are a ubiquitous part of young people's lives and substantially influence how individuals relate to one another, share information, and engage with the world (Ahn 2011; Grimes and Fields 2012; Madden et al. 2013). Different social media platforms – for example, social network sites, micro-blogs, wikis, or media-sharing platforms – allow members to share text, images, video, and other digital media. Researchers observe that individuals use these technical features to establish a variety of social and cultural practices. For instance, social media tools significantly influence how people interact socially and share information (Lewis, Pea, and Rosen 2010; Morris, Teevan, and Panovich 2010). Similarly, there has been

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much interest in understanding how social media applications may play a role in teaching and learning practices in a variety of contexts that range from informal and everyday use to formal college classrooms (Greenhow, Robelia, and Hughes 2009; Selwyn 2009; Junco, Heiberger, and Loken 2011; Junco 2012).

Initial studies have documented how social media tools help young adults to develop identity (Greenhow and Robelia 2009), negotiate campus life (Selwyn 2009), engage in a college classroom (Junco, Heiberger, and Loken 2011), or organize class activities (Lampe et al. 2011). However, other uses of social media have shown negative relationships to formal measures, such as course grades (Pasek and Hargittai 2009; Junco 2012). These disparate findings underscore the need for further research that better articulates how the design of social media tools intersect with educational environments to create new learning affordances. We define the term learning affordances as the teaching and learning behaviors that can potentially arise through the interaction of technological capabilities, features of a learning environment, and characteristics of learners themselves (Kirschner 2002). The technical features of a social media tool can guide any number of behaviors. However, the learning affordances of a tool can only be fully understood through observing its interaction with learning environments and the ways in which learners appropriate the tool for learning behaviors. It is difficult to clearly articulate the affordances and potential of social media for learning, without understanding the holistic interaction of factors in a given sociotechnical system that includes the technology, learning environment, educator practice, and learner behaviors.

In our efforts to theorize more comprehensively about the affordances and potential of social media for teaching and learning, we engaged in an iterative, design-based research (DBR) project (Collins, Joseph, and Bielaczyc 2004). One component of the project was the development of a social media application called *ScienceKit* to encourage scientific inquiry for children within informal settings. We also deployed *ScienceKit* in an informal, science-learning program called *Kitchen Chemistry* (*KC*). *KC* focuses on helping children begin to *scientize* their everyday life, or begin to understand that everyday practices such as cooking relate deeply to scientific practices and dispositions (Clegg and Kolodner 2014). By carefully designing both the technology and learning environment, we sought a holistic understanding of how social media could be designed, and what benefits to the teaching and learning process might arise from the thoughtful use of such tools.

In this paper, we briefly review research on social media and learning and highlight a need for a more nuanced understanding of the learning affordances that can arise through the use of social media tools in different learning environments. Next, we outline our DBR process that led to the current version of the *ScienceKit* app on the *iPad*™ (as of this writing) and the curricular environment of *KC*. We also describe how social and cultural practices that arise with *ScienceKit* map onto an important component of science learning: developing children's *dispositions* toward science practices such as *scientizing* their daily life experiences (Clegg and Kolodner 2014).

We then present an analysis of the latest iteration of *ScienceKit* used in *KC* that was implemented in an informal, summer camp in 2013. We show how the design decisions we made when creating *ScienceKit* interacted with the affordances of the *KC* curriculum, our child learners, and the teaching and learning behaviors that occurred in the program. Through illustrative case studies (Yin 2003), we show how the social behaviors we observed when our child learners used *ScienceKit* related to aspects of disposition that were important in the science-learning environment of *KC*. The illustrative cases begin to articulate how mobile, media-rich, social media-sharing can enhance a learning process (such as *scientizing* daily life) while also providing real-time information about learner behavior that could enhance educator practices.

Social media for learning

Our exploration into the design and use of social media for learning is grounded in an understanding of how technology, contextual factors, and the characteristics of teachers and learners interact to afford new learning behaviors. Sociocultural perspectives of learning recognize that a social media tool is an artifact that mediates the social interactions and learning behaviors that take place in a given context (John-Steiner and Mahn 1996). A sociocultural perspective pays attention to how actors (e.g., learners, teachers, facilitators) interact with one another, using the tools and resources available in a given context, and influenced by the broader cultural discourses surrounding the learning situation. In addition, learning scientists understand that technology interacts with the practices and routines of an environment (e.g., a classroom) to create learning affordances and behavior (Roschelle, Knudsen, and Hegedus 2010). This understanding helps to unpack the varied ways in which researchers have framed social media's role in learning in the prior literature.

For example, many studies of social networking sites (SNS) and teenagers document how features of the platforms – such as profile pictures and friend lists – are used to amplify their existing social lives. Young people negotiate friendships and teenage drama, provide emotional and social support, or participate in negative behaviors such as bullying (e.g., boyd 2006, 2007; Ito et al. 2010; Ahn 2012). Greenhow and Robelia (2009) highlight how these social practices comprise learning in and of itself, as teenagers leverage these platforms to develop and experiment with their personal identities. Learning in this context is not primarily about obtaining content knowledge, although explicit information asking and sharing practices can occur (Morris, Teevan, and Panovich 2010). Instead, such studies expand the notion of what *types of learning* can happen – for example, not just content knowledge but also literacy or identity – that align with the socialization behaviors that social media are designed to encourage.

Many studies examine whether an informal platform, such as *Facebook*™ or Twitter™, could be used to enhance formal learning in college classrooms. College students can in fact appropriate a social tool for formal learning means such as organizing study groups (Lampe et al. 2011). While these behaviors can occur with the right mix of *Facebook*™ friends and peers, the sociocultural context of *Facebook*™ also introduces key tensions. For example, one tension is the situation of *context collapse* that is present, in which an individual must negotiate multiple networks of people (peers, friends, parents, employers, etc.), and must make difficult decisions about what information to disclose or interactions to share (Vitak 2012). Selwyn (2009) shows how college students use *Facebook*™ to share social and factual information, but through these practices have to negotiate the very diverse roles and conflicts they experience in campus life or academics. Similarly, in their study of an international group of teenage students who used *Facebook*™ for English language learning, Lantz-Andersson, Vigmo, and Bowen (2013) found that the platform afforded students a social space to practice language skills. However, teachers and students found that learning tasks were difficult to sustain unless they engaged in boundary crossing and constantly negotiated what practices were recognized as legitimate (e.g., socializing and banter vs. formal practice of communication skills).

Such studies underscore the importance of context. Who is present in one's network influences the learning behaviors that can arise. These contextual affordances may explain the seemingly disparate findings that link social media use to formal measures such as grades. In some instances, using a tool such as Twitter™ is associated with higher student engagement and grades in a college course (Junco, Heiberger, and Loken 2011). In other university settings, it appears that *Facebook*™ use is a distraction and negatively correlated with grade point average (Junco 2012). These mixed findings suggest that the alignment or misalignment between the social, cultural, and curricular context of both the social media tool and a learning environment is directly related to learning outcomes. Socializing in an SNS naturally relates to learning outcomes such as literacy and identity, but is perhaps misaligned with an outcome such as achieving a high course grade. An SNS could be leveraged for a formal learning outcome, but requires a complex negotiation of norms, culture, and behaviors to create that alignment. In this study, we explore how the potential uses of social media could align with a learning goal of developing scientific dispositions for children.

Linking scientific dispositions and social media

Researchers suggest that one of the main goals of science education is to produce scientifically literate citizens who are able to apply and utilize science learning throughout their daily lives (Clegg and Kolodner 2014). Our goal in *KC* focuses on the notion of helping learners to *scientize* their daily lives. Scientizing is defined as the ability to recognize the relevance of science in everyday activities and then pursue inquiry-based thinking around such situations (Clegg and Kolodner 2014). Scientizing involves many learning behaviors, such as asking questions, thinking about causality in phenomenon, investigating hypotheses, and being curious and wanting to pursue discoveries. More importantly, scientizing is a disposition that must be developed, or a stable set of practices and preferences that a learner enacts as they encounter new experiences in the world.

We define disposition as the ways in which people take on the values, ideas, and participation structures of a particular discipline (Katz 1993; Gresalfi and Cobb 2006). While dispositions may develop in one context, they can be recognized when learners take on the practices of a discipline in multiple contexts (Bereiter 1995). For example, Nasir (2002) showed that basketball player dispositions do not just stay on the playing court, but can transition into the mathematics classroom and vice versa. In our research, we are actively pursuing the notion that 'scientizing means developing dispositions towards scientific reasoning' (Clegg and Kolodner 2014, 38). In order to facilitate learners' scientizing, we must develop four parts of scientific disposition: (1) conceptual and procedural understanding, (2) personal interest, (3) social interactions, and (4) personal connections. In contrast to more formalized learning goals (e.g., grades), exploring how scientizing dispositions develop through social media practices holds promise as a learning goal to pursue and understand, because both are deeply rooted in learners' own personal and cultural contexts.

In prior research, we have found that social media in science learning enables the development of analytics that illuminate how learners participate in science (Ahn et al. 2013), build scientific collaborations when face-to-face settings are difficult (Clegg et al. 2013), scaffold learning (Ahn et al. 2012) and support development of scientizing dispositions (Clegg et al. 2014; Yip et al. 2014). Our work seeks to further develop technological tools that can enhance all aspects of scientific disposition development, and articulate how social media features offer opportunities to help bridge scientizing practices across different domains.

A design-based research approach

Our goal is to understand the learning affordances, or interactions between social media tools (e.g., *ScienceKit*), learning environments (e.g., *KC*), and facilitator practice that can support these building blocks of disposition for learners. Given the complex array of factors that are involved when integrating social media and learning contexts, we employed a DBR approach (Collins, Joseph, and Bielaczyc 2004) to iteratively design an educational context and vision of learning while integrating a social media app into this learning context. Through a DBR approach, we were able to carefully configure and align the technology, educator practice, learner activities, and learning outcomes. This strategy allowed us to mitigate the tensions of alignment seen in prior research (e.g., if we had attempted to re-appropriate a tool such as

Facebook™ for a misaligned learning goal), and instead focus our research on exploring and articulating the potentially beneficial teaching and learning practices that can occur with social media.

In the following sections, we outline how our design decisions for learning and technology created these alignments. We first present the iterative design of the *KC* program, its theoretical motivation, and pedagogical design. The practice-centered learning goals of *KC* ultimately aligned well with the social interactions that are afforded by social media tools. We then briefly describe our development process for *ScienceKit*, a mobile social media app designed to promote scientific inquiry. Our design process illuminates how careful consideration of the affordances of social media technology gave us an insight into particular interaction designs that might enhance learners' scientific inquiry practices. Finally, to help unpack the potential connections between social media, scientizing, and disposition development, our study focused on two research questions:

R1: How did disposition behaviors arise from the interaction between *ScienceKit*, *KC*, peer learners, and adult facilitators in the program?

R2: How did *ScienceKit* afford particular disposition behaviors from learners, and what was the unique contribution of the technology in concert with other factors such as the *KC* curriculum, and adult facilitators?

Kitchen science investigators to KC: coordinating people and practices

We started our DBR process with the broad goal of helping elementary- and middle-school learners develop skills to *scientize* their daily life experiences. Informed by sociocultural and discourse perspectives of learning (e.g., Lave and Wenger 1991; Gee 2000), we designed a program where children could engage in an everyday discourse (e.g., cooking and eating) and link these practices to scientific discourses (e.g., experimenting with various ingredients and cooking procedures). We hypothesized that if we could help children begin to *scientize* their daily lives, they could see themselves as more science-savvy or capable through their experiences.

Starting with cooking as a motivating, everyday context for scientific inquiry, we developed the *Kitchen Science Investigators* (KSI) out-of-school program. The initial design of KSI focused on a sequence of activities from semi-structured experiments (where learners are given kitchen science experiments to carry out) to choice investigations (where learners carry out scientific investigations to perfect dishes of their choice). Multiple implementations of this approach revealed the importance of continuously focusing learners to see how each activity and related inquiry practice would contribute to the iterative goal of perfecting a dish. We developed a model of activity sequencing, facilitation support, and small and whole-group conversations to address this need (Clegg et al. 2006).

As we implemented this model of life-relevant learning with elementary- and middle-school youth, we began to see alternative 'styles' of scientific inquiry approaches that learners took on in KSI (Clegg and Kolodner 2007). For example, we found that while some learners took more traditional, expected approaches to scientific inquiry (preferring rule-based, abstract styles of investigation), others took 'bricoleur' approaches to science (preferring emergent investigations through manipulating objects) that were often overlooked. Our analysis revealed that both styles of participation included legitimate scientific inquiry practices. Yet, learners who took traditional approaches were more easily recognized for their contributions than those taking alternative, bricoleur approaches.

As we characterized the scientific and personal experiences learners had in KSI, we began to call them *scientifically meaningful experiences*. We developed a growing understanding of what these experiences looked like, and how they developed, and what teaching and facilitating practices could better support them (Clegg, Gardner, and Kolodner 2010). Our analysis of KSI implementations illuminated the importance of collaboration with other learners and facilitators to fuel learners' scientific experiences. We found that learners engaged deeply in scientific investigations as they worked with others who shared their interests and similar approaches to scientific inquiry. Adult facilitators played crucial roles in helping learners engage in science in the context of their interests, by amplifying learners' questions and curiosities and connecting them to opportunities for scientific investigation. Opportunities for fun, playful, social interactions between learners and adult facilitators were extremely important to help learners open up and express their scientific interests, goals, curiosities, and ideas (Clegg et al. 2006). This work established the importance of supporting the building blocks of disposition for learners in order to promote the development of deepening and sustained engagement with science across life contexts (Clegg and Kolodner 2014).

We next focused on iteratively refining KSI into a program called *KC*, with a goal to more effectively integrate technology into the environment. We recognized the need for technology to support learners' scientifically meaningful experiences by giving them the ability to capture their scientific practices (e.g., data collection, hypothesis generation) and their personally meaningful experiences (e.g., recipe successes, playful moments) (Clegg et al. 2012). Our aim was to investigate how various technological features could be integrated into the *KC* learning environment structure to enable learners to connect their personal experiences to scientific practice more deeply.

Designing ScienceKit: aligning social media to learning practices

The first iteration: scaffolding contributions

We began the design process that ultimately led to *ScienceKit* in the autumn of 2011. Our first prototype was called *SINQ* to allude to the use of social media affordances to sync collaborative *S*cientific *INQ*uiry across many users (Ahn et al. 2012). We defined key scientific inquiry practices – for example, forming a question, devising a hypothesis, and planning a project (Olson and Loucks-Horsley 2000) – and designed the online application to scaffold this process for learners. A *SINQ* user could contribute simple text-based components of scientific inquiry, such as a question, a hypothesis, or an idea for an investigative project. The system would then aggregate these snippets into larger, coherent projects. We designed *SINQ* to allow users to contribute what was most salient and comfortable, but aggregated and guided these contributions to develop coherent project ideas (see Figure 1). The key feature of this initial prototype was designing the interface to prompt learners to organize and reflect on their textual contributions as pieces of scientific inquiry (e.g., posing questions, forming hypotheses, devising project ideas).

Second iteration: designing social scaffolding with kids

We brought this prototype to a participatory design team called Kidsteam, at the University of Maryland. Kidsteam is an intergenerational team that is typically composed of six to eight child designers (7–11 years old) working closely with four to six adult researcher-designers (Druin 1999, 2002). In our first Kidsteam participatory design session with *SINQ*, we asked the children to brainstorm ways to design social feedback mechanisms into the interface. We wanted to understand how designers might utilize these features as a form of social vetting that could also act as a scaffolding mechanism during inquiry (Gubbels et al. 2012). We integrated Kidsteam insights from this first

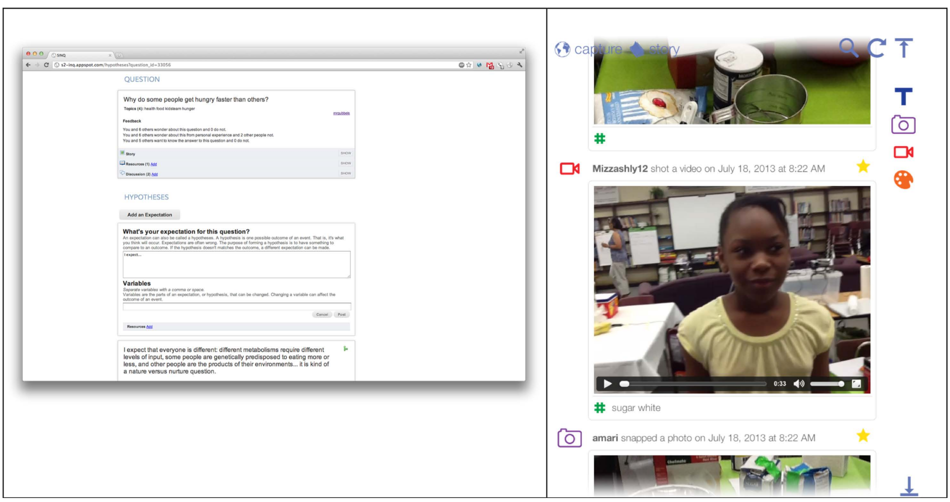

Figure 1. (left) Screenshot of *SINQ*, (right) screenshot of *ScienceKit*.
Note: we have informed consent and permission from our *KC* participants' parents to publish their images and artifacts.

participatory design session to transform generic voting mechanisms such as a like or favorite button, into specific voting criteria that could serve as a form of social scaffolding. We implemented *SINQ* in the *KC* program in the spring of 2012, and the details of this study helped us validate the value of cognitive scaffolding and social vetting as children created their Choice Day experiments (Ahn et al. 2013; Clegg et al. 2013).

Third iteration: mobile, social, self-expression

In subsequent design sessions with Kidsteam, the child design partners often told us that the design and user interface of *SINQ* was, in their words, 'boring'. They described *SINQ* as a technology tool a student would use in 'school', not in their everyday lives. Our participatory design experiences helped us begin to understand the importance of supporting both cognitive scaffolding and everyday *usability* or *engagement*, if children were to use this social media application to capture elements of their daily life, share these contributions with peers, and in the process scientize their everyday life experiences. One aspect of current social media tools, such as *Instagram*™, *Facebook*™, and other platforms, is the ability to easily capture and share multiple forms of media, such as photos and videos.

In our final design iteration, we integrated media-sharing and expressive features, with the cognitive scaffolding around scientific inquiry that was featured in *SINQ*. In addition, we evolved the interaction design from being a primarily browser-based, text-heavy mode of interaction into truly mobile, multimedia-based participation (Figure 1). Through several more iterations of design and development to improve usability and engagement, we refined the application into an *iOS*™ native app called *ScienceKit. ScienceKit* allowed for more diverse media types. Learners could now scientize their experiences in the form of photos, drawings, video, and textual contributions (Figure 1). Networks of friends in their social media feeds then could see these contributions. Our experiences highlighted our evolution of thought from an initial focus on designing for cognitive scaffolding (*SINQ*) to also consider the profound importance of social media (*ScienceKit*) to enable *social engagement* and *personal expression* in the learning process.

Methods

A deep dive: case study of scientizing with ScienceKit in KC

At this stage, we shift our analytic lens to the ways in which *ScienceKit*'s design supports scientizing in the context of *KC*. We employed the methods and standards of a single case study of an implementation of *KC* (Yin 2003) in the summer of 2013. We implemented *KC* and *ScienceKit* in an out-of-school, summer camp program over four consecutive half-days (Monday–Thursday,

Table 1. Facilitators and learners in this case study of *KC* (the names of facilitators discussed in this case study report are italicized).

Facilitators	Learners and grade
Tonya	Shaun, 5th
Jalen	DeMarco, 5th
August	Aziza, 5th
Emma	Noah, 4th
Donald	L'arielle, 4th
Charlotte	Juan, 4th
Eliza	Allen, 4th
Matthew	

Notes: Facilitator names have been changed for anonymous review. Learner names have been changed to protect the identity of participants.

approximately 4.5 hours per day) in a lower socioeconomic status public school in the Washington, DC metropolitan area. Seven learners (ages 9–11) participated in the program and our *KC* team comprised eight adult facilitators (Table 1). The first two sessions were semi-structured days and the last two days were Choice Days. On Day 1, learners observed brownies made with different amounts of eggs and did an experiment with eggs, oil, and water to understand how eggs work in brownies. Day 2 involved a cookie experiment to test and explore the roles of different leaveners. On Days 3 and 4, learners chose new dishes to perfect and worked on their Choice Day investigations with facilitators.

Data collection and analysis

Our goal in this analysis was to understand the ways in which *ScienceKit* afforded particular disposition behaviors from learners, in concert with other factors from the *KC* learning environment. To this end, we started with a broad analysis of the data collected in *KC*. First, we analyzed short *personal* reflection videos that learners created in *ScienceKit* at the end of Days 1–3 in which they responded to the prompt: 'Today, I was more like a … Chef, Investigator, Scientist, or a Combination (tell us which combination you felt like), or something else (tell us what or who). Then, tell us what you did to make you feel like that.' We transcribed each learners' personal reflections and conducted open coding (Corbin and Strauss 2008) to identify themes for each learner based on how they described themselves as developing learners, chefs, investigators, and scientists. We coded these entries for how learners came to see themselves and which *KC* experiences they referred to in explaining their evolving self-narratives.

Next, we developed case write-ups of group experiences in the program, using a combination of observation data. Each day we collected video recordings of all activities and discussions in *KC* to understand learner interactions and participation. Additional data sources included interviews with each learner, focusing on their use of *ScienceKit*, their experiences in science, and their experiences in *KC*. Facilitators recorded post-observational field notes of their experiences each day in *KC*. We also collected analytics (e.g., time stamps, account logins, *ScienceKit* posts) as participants posted contributions to the *ScienceKit* app. We coded the *ScienceKit* posts describing each media file and coding entries for aspects of learners' scientific practice related to the types of interest-based, social, and personally meaningful experiences learners were having with the technology (Clegg et al. 2012).

As we wanted to understand how the deeply engaging experiences learners were having with *ScienceKit* influenced their scientizing, we focused on observing how (1) the ways learners' engagement with *ScienceKit* developed over time, (2) ways their use of *ScienceKit* involved development across the disposition building blocks, and (3) ways learners viewed *ScienceKit* and their use of the tool. We identified three vignettes in this implementation of *KC* where learners simultaneously initiated the use of *ScienceKit*, were deeply engaged with the tool, and where there was recorded, personal reflection on the experiences learners were engaged in (either prior to, during, or after the experiences). In each vignette, we triangulated observations of the group experience with an analysis of the entries that the focal learners created in *ScienceKit* to characterize (1) the experience, (2) the ways learners' use of *ScienceKit* influenced their development across the disposition building blocks, and (3) the roles *ScienceKit* played in influencing learners' scientizing within the context of *KC*. We focused particular attention on understanding the ways in which learners' use of *ScienceKit* influenced and was influenced by the *KC* learning environment.

Findings

Introduction to the vignettes

We structure our presentation of the three vignettes in the following manner. First, each vignette has an introductory summary of the context and sequence of the vignette, and the main point of the vignette. We also describe the primary participants – *facilitators* (italicized) and learners – in the vignette and how they fit into the context. Second, we provide rich descriptions of the vignettes. For each description, we show how the learners in a given implementation (a) engaged with *ScienceKit*, (b) engaged with elements of *KC*, (c) and how the children enacted aspects of disposition. Finally, we present the analysis of the vignettes and describe how the disparate elements came together in a unique way, what disposition practices we observed, and how the evidence in the vignette reflects disposition development.

Vignette 1: breakfast scientizing

Introduction. In this vignette, which covers Day 1 of the *KC* program, we illustrate how the children and facilitators acclimated to both *ScienceKit* and *KC* in the beginning of the program. The process began with the learners' introduction to investigating and scientizing. The vignette also shows the initial steps that the children and facilitators took to explore the use of *ScienceKit* in their scientific investigations. The interactions involve six of the seven children (Aziza, L'arielle, Noah, Shaun, Allen, and DeMarco), two of the facilitators (*Tonya* and *Emma*) who guided the learners in their use of *ScienceKit*, and two other facilitators (*Jalen* and *August*) who helped set the tone for how the children could playfully use *ScienceKit*. We started the day's activities by introducing the children to facilitators and to *ScienceKit*. Our discussion then shifted to exploring what it means to be a scientist, investigator, and chef. Finally, the learners (without direction) carried *ScienceKit* and the concepts introduced earlier to the breakfast table and began to naturally use *ScienceKit* in the learning environment by investigating their breakfast.

This vignette began when the children trickled into *KC* for the first time. We provided them their own *iPad*™ with *ScienceKit* and asked them to use the app to introduce themselves by using text, drawings, videos, photos, or some combination. All learners enthusiastically began to use *ScienceKit*. While there was some instruction for using the *iPad*™, such as how to 'flip' the camera from front camera to the back camera, learners immediately found ways to use *ScienceKit* to express themselves. The expressions ranged from socializing while taking 'selfies' to making drawings about personal interests such as *Minecraft*™ characters. Facilitators also used this time to playfully interact with learners (e.g., photobombing) and to encourage learners' playfulness and personal connections to *ScienceKit*.

Aziza and L'arielle showed their interest in socializing while using *ScienceKit* to take photos, one of which was photobombed by *Jalen*. Another learner, Noah, showed interest in the photo tool and *August* encouraged him by saying he liked Noah's photo. Shaun drew a picture of a smiling dog in *ScienceKit* with the caption 'I like to move it move it'. Allen was also drawn to the sketch tool, where he made several sketches involving characters from the computer game *Minecraft*™. By the end of the session, most learners seemed acclimated to using *ScienceKit*, including sharing entries via the timeline.

Introducing KC and dispositions. The *KC* program began with a whole-group discussion led by *Tonya* (lead facilitator). *Tonya* started by discussing the meaning of scientific investigation. When asked, Shaun, an outgoing learner, defined an experiment as 'a project', while other learners seemed reluctant to offer definitions of scientific investigation. However, learners were more engaged when the subject shifted toward the three roles or dispositions learners take on in *KC*: chefs, investigators, and scientists. Shaun took particular interest in describing these roles, explaining that a chef gets 'food to taste good', while investigators 'scope stuff'.[1] *Tonya* then offered example investigative questions such as 'Why are strawberries the way they are?' When asked about what a scientist does, learners stated that scientists did experiments. While they were reluctant to discuss what an experiment was, the children were excited to discuss the ways in which scientists conduct experiments. *Tonya* then explained that later in the week the learners were going to come up with their own questions to investigate.

Carrying ScienceKit to breakfast: initiating scientizing practices with ScienceKit. The children also had breakfast on each day of the program. Breakfast on the first day provided many examples of how *ScienceKit* could be integrated into the group setting while helping facilitators encourage scientific dispositions and sharing. The learners brought their *iPads*™ to the breakfast table (without any prompting). While they did not initially use *ScienceKit*, Noah, a more reticent learner, soon took interest in the food at the table and used *ScienceKit* to take photos of breakfast items that piqued his interest. He snapped a picture of the ingredients label on his milk carton and wrote 'The nutrition' as a caption (Figure 2). Meanwhile, *Emma*, looked for food allergy information in the ingredients label of the learners' breakfast containers. She made a casual observation to Noah that the cereal *Apple Jacks*™ actually has apples as an ingredient.

The next food question was from a more energetic learner, Shaun, who upon observing a container of strawberries on the breakfast table asked whether strawberries had vitamin C. *Emma* told Shaun, 'that is a good question', looked up the answer using her *iPhone*™, and showed it to Shaun. During this exchange, Noah continued his investigator role and took a photo of the strawberries, making the observation in *ScienceKit*: 'Some probably got more care than others. Some are bigger than others' (Figure 2). *Emma* also saw that another learner, DeMarco, was interested in videography, and asked him to create a video asking if *Apple Jacks*™ actually have apples. To help him answer the question, she gave him the *Apple Jacks*™ container, pointing out the ingredients list. DeMarco took this challenge, proceeded to look at the ingredients, and created a video explaining that *Apple Jacks*™ do have apples as an ingredient. Learners and facilitators took immediate interest in DeMarco's post. For example, Noah played the video the moment it appeared in the *ScienceKit* timeline. In addition, *Emma* and *August* complimented DeMarco on his video investigation, encouraging his efforts.

Near the end of breakfast, Allen browsed through the *ScienceKit* entries made by his fellow learners and saw the milk ingredients photo taken by Noah at the start of breakfast (Figure 2). *Emma* then asked Allen if he thought milk has sugar as one of the ingredients. L'arielle and Aziza overheard *Emma's* question and laughed while playfully repeating it back to each other. DeMarco overheard the girls having fun and asked L'arielle and Aziza why they were laughing. Hearing their new question, DeMarco then decided to make another investigative video, this time asking whether milk has sugar as

Figure 2. (upper left) Noah – 'The nutrition', (upper right) Noah – conjectured about the quality of the strawberries, (bottom) Allen – viewing Noah's nutrition photo in *ScienceKit*.

an ingredient. As breakfast ended, DeMarco crafted a *ScienceKit* video describing his question, using the milk ingredients list to posit his claim (that milk does not have sugar), then shared his video with everyone. Over the following days, DeMarco remained curious about the ingredients contained in various foods.

Vignette 1 analysis

Modeling, setting and aligning expectations of scientizing with personal interests. This vignette shows learners' initial orientations to *KC*, *ScienceKit*, adult facilitators, and scientizing practices in *KC*. The learners began to appropriate scientizing practices themselves with help from *ScienceKit*, facilitators, and one another. First, *Tonya's* introduction of the roles in *KC* in the whole-group discussion set expectations of scientizing in the group. *Tonya* made it clear that in *KC*, learners were expected to be curious, ask questions about their interests, and engage in social interactions by sharing those interests with the group. She then modeled examples of what such questions might look like. *Tonya* also foreshadowed that they would later engage in experimentation, investigation, and 'scoping' to inform these questions and begin to make claims. Learners were able to use their own words and terminology to define scientific investigation and practices, and *Tonya* tried to discuss scientizing practices using their terms. This introduction was intended to let learners know that these scientific inquiry practices in the contexts of their interests were valued and expected in *KC*. Here, learners began to be exposed to the conceptual and procedural understandings needed for the week.

Next, we instructed the learners to use *ScienceKit* to introduce themselves to the group, without emphasizing any specific scientific practices or expectations. This activity enabled learners to use *ScienceKit* as a tool to continue to express their interests such as their hobbies and everyday selves (e.g., *Minecraft*™ play). The relationship with *ScienceKit* also moved to breakfast, where the learners made several observations that interested them, such as the quality of the strawberries at the table, and shared them with others. During this time, *Emma* modeled personal and scientific practices with technology as she looked for ingredients to detect potential allergy dangers. As the learners began to take up some of the practices discussed in the whole-group conversation (e.g., Noah and Shaun's initial questions about strawberries and ingredients), *Emma* helped position learners to start bridging their interests with scientific and investigative processes. *ScienceKit* enabled *Emma* to both model and encourage learners to use scientific practices as she invited learners to create entries in *ScienceKit*. She supported their scientizing by guiding them toward tools (e.g., package nutrition information) to answer the questions relevant to their interests.

Learners enacting scientific practices in social interactions. As learners used *ScienceKit* to create entries, those who were shy about raising their hands and speaking in front of the group, nevertheless took interest in the entries appearing in the *ScienceKit* newsfeed. For instance, Noah's initiative to extend the ideas from the whole-group discussion into breakfast without explicit prompting is easy to overlook without analyzing the *ScienceKit* artifacts. As learners observed their peers while socializing, they took up similar scientific practices in their own ways. For example, as DeMarco observed others posting questions to *ScienceKit*, he began to assume this practice himself through creating videos. DeMarco's highly visible video investigations were both educational and entertaining. These inquiries started with *Emma* prompting the video of *Apple Jacks*™ and other facilitators later encouraging the investigation. DeMarco then used that practice to extend the milk investigation initiated by Noah. *Emma* never asked DeMarco to make the milk observations. His line of questioning grew over time as the learners modeled *Emma's* various investigations. We note that *ScienceKit* enhanced these interactions by allowing learners to easily convey their interests while socializing with each other. These *ScienceKit* features ultimately enabled learners to see how they could enact their own scientific investigations after seeing the process modeled by others.

Vignette 2: cookies and leaveners

Introduction. In this vignette, we focus on the interactions on Day 2 of *KC* during a group discussion and demonstration that examined the differences between baking powder, baking soda, and cream of tartar in the baking of chocolate chip cookies (see the appendix for more information on the specific reactions). While *Jalen* led the discussion, all facilitators (*Tonya, August, Emma, Donald, Charlotte, Eliza, Matthew*) and learners (Shaun, DeMarco, Aziza, Noah, L'arielle, Juan, Allen) were involved. During this session, the children observed leavener reactions by baking cookies with different leaveners (i.e., baking soda, baking powder, or baking soda with cream of tartar). The group discussion centered around a paper chart spread out on the floor that was divided into a 3×2 grid outlining the experimental conditions and observations about outcomes within those conditions. Children and adults gathered around the floor as *Jalen* led the discussion and demonstration (Figure 3).

ScienceKit as an artifact for group discussion. The group discussion began with several observations of the cookies. In particular, one of the groups had made a mistake in the baking powder cookies and burned them. The children made observations of the color, texture, and size of the cookies. In contrast to previous discussions, the children were much more quiet in this activity. It is possible that the children were physically tired since they had just made the cookies, or the conversation was not as interesting because of the structured format. Some of the children, such as DeMarco and Noah, recorded the conversation using *ScienceKit*. Other children, like Allen and Shaun, used *ScienceKit* to sketch pictures of the cookies. The conversation focused on the difficulties of comparing the cookies with each other because each group made a different amount of cookies (9 baking soda cookies, 11 baking powder cookies, and 12 baking soda/cream of tartar cookies), using approximately the same amount of ingredients.

Since a direct comparison of the cookies was difficult, *Jalen* focused the learners' attention on directly comparing the effect of hot water in cups of baking soda, baking powder, and baking soda and cream of tartar. *Jalen* set up equal volumes of these reagents. As soon as he started to pour hot water into the baking soda, the children immediately perked up and pulled out their *iPads*™ to record the demonstration. Each child suddenly started to take video and photo recordings using *ScienceKit* from multiple angles (Figure 3).

Figure 3. Gathering together for the discussion on cookies and leaveners. The children immediately and spontaneously pull out their *iPads* to record the demonstration.

Learners energetically captured the phenomenon. L'arielle started to record the bubbles underneath. The children began to call out observations of the foam and bubbles being generated from the water and powder interactions. The children became excited and wanted to take measurements of the temperature of the water. Some used magnifying glasses to examine the reaction more closely. Instead of sitting passively, learners crowded around the demonstration space to capture their observations and measurements (Figure 3). During the demonstration, DeMarco excitedly showed *August* his recordings, 'I got everything live right here!' *August* showed DeMarco how to use *ScienceKit* to make captions of his recordings. *Jalen*, aware that the mixtures were edible, recommended that someone tastes one of the solutions. Noah and Juan immediately volunteered and Aziza captured their disgusted reactions to the salty solution.

After lunch, we continued the discussion about the cookies and leaveners. *Jalen* asked the children to describe what they observed in each of the cups of powder with water. The children vividly described each of the cups and some learners referred to their pictures and recordings in *ScienceKit* to explain their observations. They described the position of the bubbles, colors, and amount. *Jalen* asked, 'What do you think baking soda is?' DeMarco stated, 'Arm and Hammer?'

Jalen read the ingredients list on the box, stating that baking soda is made up of sodium bicarbonate and that baking powder is also made of sodium bicarbonate and a dry acid (cream of tartar). He attempted to make the connection that baking powder has two main ingredients and baking soda has one primary component. Simultaneously, some learners began playing their videos in *ScienceKit*, which posed a minor distraction. *Jalen* started to relate the typical vinegar and baking soda reaction that the children had seen before. They asked to record him pouring a little vinegar into the baking soda. *Jalen* emphasized that vinegar is a wet acid and that the reaction between the acid and base (sodium bicarbonate) created carbon dioxide. *Jalen* also asked the children what the reaction tasted like, to which Juan exclaimed it did not taste good, but was salty. *Jalen* wrote salt on the board and explained that salt is a byproduct of the reaction. He also demonstrated another reaction, showing that cream of tartar (dry acid) does not react with the baking soda. Juan yelled out, 'it (the acid) has to be wet!' *Jalen* asked, 'Well why does it (the acid) have to be wet?' Some children called out 'activate'. Juan noted, 'Because if it's wet and liquidy, so then it can react and mix', 'they aren't really mixing well', and 'if it's wet, it has to be liquid, for it can mixture together, mix together'.

Vignette 2 analysis

ScienceKit as a recording mechanism. In this vignette, we observed how learners used *ScienceKit* to make recordings of the discussion for themselves. In our analysis of what the learners recorded, we found that the recordings were not always distractions or superfluous. Rather, the camera perspective always focused on the speaker of the discussion and the demonstrations of phenomena. Learners used *ScienceKit* to record, follow, and engage with each other and the facilitator, engaging in the social interactions that are fundamental to building disposition. We believe the learners were trying to develop personal connections between themselves, the adults, and their peers without having to be vocal or active during the group discussion. Some of the quiet learners also drew pictures of the discussions, while others inserted questions. *ScienceKit*'s ability to record and share helped us see what learners attended to during a group discussion (e.g., what they chose to record), and how they utilized their artifacts in *ScienceKit* to connect with each other, and use the 'backchannel' of *ScienceKit* entries to help them contribute to discussions and explanations of the experiment.

Disposition development means getting up close and personal. ScienceKit also allowed learners to get up close and explore. We believe the actions of the learners here indicated disposition development toward conceptual and procedural understanding of science. Initially, the children were less vocal than we had previously seen. However, a shift in interaction occurred when the children had a chance to see *Jalen* preparing a demonstration with water and the different powders. Without hesitation or prompting, learners immediately pulled out their *iPads*™ and physically moved themselves closer to record the demo.

This shift in activity and increase in recording with *ScienceKit* coincided with the children calling out more observations of phenomena, devising explanations and talking with peers, and fostering calls for additional activities (e.g., using the thermometer to measure water temperature, using the magnifying glass to more closely observe the chemical reactions in the cups). The children also recorded themselves using these tools. Here, *ScienceKit* usage became more than just a personal social media tool to capture fun photos and recordings. Learners' interactions suggest they started to understand *why* they should use *ScienceKit* as a way to record observations for later reflection, to create explanations, and as an artifact around which to debate and converse with their friends about their observations.

Often, science demonstrations can be construed as dangerous and distant. However, we created a safe demonstration that allowed the children to get very close to touch and taste the reaction, and to choose what to record. Even the most reticent learners got on the ground and began to explore. We observed that hands-on and up-close recordings build interest. For us, interest meant showing the children the relevance and excitement of the dynamic, rapid chemical reactions. It is plausible that learners could capture observations with other tools such as a notebook and pen. However, the affordances of *ScienceKit* allowed them to record in real-time, with media, and socially, in ways that aligned with how they conversed and interacted with their friends. The children showed that they wanted to get up close, take video, and photo recordings of the dynamic demos and share with others. This helped to build further interest in disposition development.

ScienceKit supported learners' behaviors in reflection and sharing, which increased their social interactions with each other and the adults around science. We observed children searching through their *ScienceKit* accounts to find information to present and share with others. The integrated media (e.g., drawings, photos, videos) allowed for clear and easy access to the information and learners were excited to share their information captures with others. Learners could also take photos of one another during the discussion, allowing them to personalize information they gathered.

Vignette 3: personal reflections

Introduction. In addition to the opportunities *KC* learners had to develop their scientizing dispositions and practices through group activities, personal reflection videos afforded each learner personal, end-of-day moments to reflect upon these activities. The following vignette comprises excerpts from two *KC* learners' daily reflections and personal interview data. In contrast to the more community-oriented analyses of our previous vignettes, these interactions focus on two learners individually. During moments of personal reflection, each learner would work with an adult facilitator or a fellow learner, using *ScienceKit* to record a three-minute review of what she or he had done that day. Importantly, from a disposition perspective, we also asked learners to consider how they might identify themselves in the role of a working professional (e.g., chef, scientist, or investigator, or any other specific type of persona that came to mind). We recorded the first personal reflection, of 10-year-old Aziza, during the fourth and final day of *KC*. During her reflection, Aziza details how she would describe *ScienceKit* to friends. Ten-year-old Noah is featured in our second personal reflection, which was recorded at the end of our first day of *KC*. Their interactions underscore *ScienceKit*'s effectiveness at capturing and preserving scientizing moments that can be shared with *KC* peers or other community audiences (e.g., family, friends, educators).

Aziza's personal reflections. To start, *Tonya*, asked Aziza to imagine that she was describing *ScienceKit* to a friend. Throughout the discussion, Aziza repeatedly held up her *iPad*™, scrolling through *ScienceKit*'s media feed and turning it toward *Tonya* when she found evidence to emphasize her talking points (Figure 4).

> Aziza: 'I'm telling one of my friends that ScienceKit is really fun. You can … draw pictures and text and you can video record anything you had done. … Like when me and my group was doing one of the projects about the brownies, I had video recorded what I had done and all the things we had learned, and then I had drew a picture of what I had did, too … '

When asked how she thought *ScienceKit* had helped her 'do science', Aziza indicated that she was not only able to capture her experiences, but she could also share what she and her *KC* partner had done. Likewise, she could see what other *KC* learners had accomplished.

Figure 4. Aziza shows *Tonya* her and her partner's *ScienceKit* observation artifacts to emphasize their efforts to record and share their experiences with others.

> Aziza: '[ScienceKit] helped me by letting me video record what we had done and then they'll pop up [i.e., in the ScienceKit social feed] … I can watch what I record and that helped me by letting me take pictures of the things I had learned and … we went through them with my other friends, to see what they has, and what my group had took pictures of'.

When *Tonya* asked for more details on when and how Aziza reviewed things that other learners had done, Aziza emphasized that she reflected on them *after* she and her partner had finished their activities.

> Aziza: '[ScienceKit] helped me *after*, like when I go on my app … I can see some of my friends' amazing pictures … or videos. [Aziza then flips through pictures and videos on her iPad™ to show Tonya examples as she talks.] Like, these are the things that we had done today … .'

Noah's personal reflections. Similar to Aziza, Noah also took the opportunity to share observations, questions, and evidence he had recorded.

> Noah: 'Today, I did a lot of different things. Like … I did a photograph of the water, oil, and eggs.'

As he talked, Noah held up his *iPad*™ and pointed to a photo he had taken during a semi-structured activity, in which his group mixed eggs, oil, and water to observe each ingredient's individual properties as well as the way in which eggs promoted both the leavening and mixing of oil and water. After showing his photo to *Eliza*, Noah continued to scroll through several media artifacts in silence. After a moment, he stopped when he found another of his photos, and commented:

> Noah: 'Um, I made a observation – um, the heaviest is the egg – the oil is the lightest … and the water is in the middle.'

Eliza: 'That's you! … Shaking the oil and water … . What did all this make you feel like today?'
Noah: "Um … made me feel that … you can do different things … And I – had a question. I said, 'I wonder if the oil will float?' [pointing] 'and … it did.'

A moment later, while still quietly scrolling through *ScienceKit*'s media feed, Noah responded to *Eliza's* identity question (i.e., 'What did this make you feel like?'):

> 'Today I felt like a investigator because … I made a uh … hypothesis … A hypothesis about the oil being … um … hold on … being lighter than the water … And I was ... correct. Because the oil *was* over the water. … I was right. … So I investigated … to see if my hypothesis was correct.'

Noah ended his comments with a little smile at *Eliza*.

Vignette 3 analysis

Our analysis of Vignette 3 offers an insight into our research question, 'How did *ScienceKit* afford particular disposition behaviors from learners, and what was the unique contribution of the technology in concert with other factors?' Aziza's conversation reflects her views about the appeal of *ScienceKit* from three aspects of scientific disposition: social interactions, interest, and personal connections. Noah's comments reveal two aspects of scientific disposition: they illuminate the ways in which *ScienceKit* enabled Noah to share his developing procedural knowledge, and his growing personal pride in his scientizing efforts.

ScienceKit supported social scientizing. Could Aziza have shared her experiences in the same way without *ScienceKit*? She may have been able to present her facilitators with sketches or notes from a more traditional notebook. However, it is unlikely that she could have discussed or compared the work of other learners in her *KC* community in the spontaneous way that she was able to share her *ScienceKit* media stream with *Tonya* (or her fellow learners). Aziza's language and gestures reflect her interest and engagement in the media she recorded, as well as the artifacts recorded by her peers: 'I can see some of my friends' amazing pictures.' By archiving her work and her partners' work in one repository, *ScienceKit* also enhanced social interactions that support inquiry and comparison: 'we just went through [the media on *ScienceKit*] with my other friends, to see what they has, and [to show] what my group had took pictures of.' Interactions like this, in which learners can share and compare various multimedia observations and evidence that had been recorded *in situ* and then archived in one repository, is one potential affordance of social media tools such as *ScienceKit*.

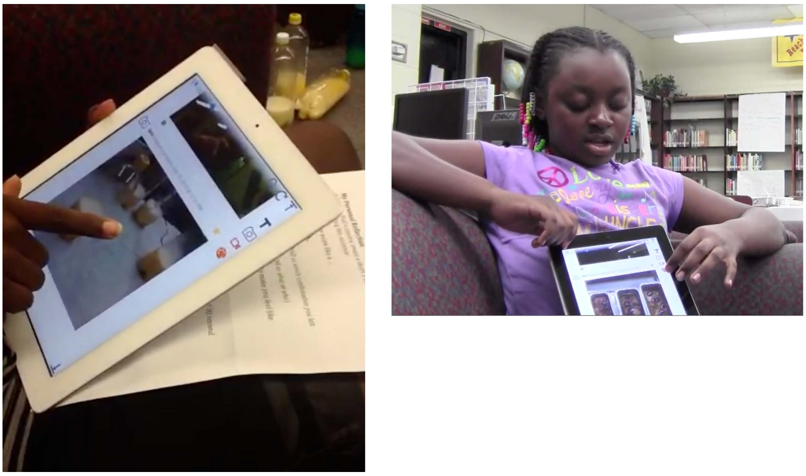

Figure 5. (Left) Noah showing the adult facilitator his *ScienceKit* artifact as he explains his questions and hypothesis about the water, oil, and egg mixture. (Right) Aziza demonstrates how to launch (and subsequently use) *ScienceKit*'s 'Drawing' tool.

ScienceKit supported personal scientizing. Later during Aziza's conversation, she also expressed how much she personally enjoyed the drawing feature in *ScienceKit*, and how it surprised her that she would be able to draw as well as take photos and videos. When *Tonya* asked her how she used *ScienceKit*'s drawing tool, Aziza proudly explained the drawing feature (see Figure 5), connecting her personal interest in drawing to an opportunity to demonstrate her knowledge of the app and its use in *KC* activities. Throughout her conversation with *Tonya*, Aziza used *ScienceKit*'s media stream to punctuate her comments. Thus, the app further enabled her to showcase her and her partner's efforts to engage in scientific inquiry practices to her facilitators.

ScienceKit afforded media-rich mechanisms to develop and demonstrate procedural understanding. Noah was one of the more quiet and serious participants in *KC*. He was not as outgoing as Aziza, and rather than stopping to compare other learners' artifacts, Noah concentrated more on his own *ScienceKit* entries during his personal reflection. He emphasized a growing procedural and content understanding aspect of his scientizing disposition as he appropriated and used language such as, 'I made a observation', 'I had a question', and 'I investigated to see if my hypothesis was correct.' Despite his quiet and introspective tone, Noah also revealed his personal interest and investment in his scientizing efforts, by showing us rare smiles as he pointed out each entry. He demonstrated quiet pride when he emphasized to his adult facilitator, 'And I was right.' In contexts other than *KC*, Noah might not have the opportunity to quietly record his observations – in the moment – with a tool like *ScienceKit*. Furthermore, using *ScienceKit*'s accessible media stream, a subdued learner like Noah was afforded the chance to easily share his personal artifacts with a facilitator, to demonstrate his developing procedural knowledge, and to reflect upon his process with pride. Even the most astute facilitator might not have the opportunity to follow Noah's growing body of observations and evidence without the benefit of a community-based, yet individually tagged knowledge repository like *ScienceKit*, coupled with the personal reflection time we had built into our daily *KC* activities.

In these individual vignettes, the multimedia artifacts in *ScienceKit* became the centerpiece of discussion for each *KC* learner. Without the app, Noah might not have been able to demonstrate his developing scientific vernacular or his systematic approach to questioning, observing, and hypothesizing. Likewise, Aziza would not have been able to share the ways in which she could review and compare her artifacts with those of her friends, learning from the examples of others as well as her own efforts. Neither learner would have had the opportunity to put their developing dispositions on display as they used their *ScienceKit* entries to augment discussions with adult facilitators and peers. Finally, we used *ScienceKit* not only to gain an insight into our learners' actions during primary *KC* activities, but we also benefited from their archived personal reflections, which were easily recorded and reviewed. Such archived meta-views into our learners' dispositions afforded us a rich, persistent, and evolving perspective on each learner.

Discussion: reconfiguring the learning environment with social media

The illustrative case studies of our work with *ScienceKit* and *KC* make several contributions toward articulating the potential affordances of social media for learning. First, we argue that any discussion of social media and learning cannot be divorced from the specific sociocultural context of a given example or project. Much of the prior literature on social media in learning contexts typically attempts to take existing social technologies and implement them mainly in formal contexts. Thus, one may find very different learning behaviors and outcomes when using a tool such as *Facebook*™ in college or high school, in formal or informal learning contexts, and with different cultural or social situations. This sensitivity to context sharpens our focus to better understand how the conditions created by *KC* and *ScienceKit* related to the learning behaviors we observed.

KC is a program that fore-grounded the social and dispositional aspects of science learning over merely acquiring content knowledge. We asked learners to engage in life-relevant tasks such as cooking, and in the process learn how to scientize their activities or understand how their everyday actions are valid aspects of scientific practices. We designed *ScienceKit* to enable individuals to easily capture their daily lives in rich media (photos, drawings, video, and text) and share them with a network of friends. The app also evolved from being a browser-based, text-heavy platform to entirely mobile (on the *iPad*™) and media-rich. These design decisions profoundly related to the learning processes we observed with learners.

For example, learners in *KC* often moved freely about the room, undertaking different cooking tasks, observing their friends, or coming together in whole-group discussions. Almost always, the *iPad*™ and *ScienceKit* were at the ready for our learners, and they fluidly integrated their technology behaviors with their learning behaviors. The process of recording a video of one's experiment, in the moment, could only happen because of the affordances of choosing a mobile, media-rich design strategy. *ScienceKit*'s focus on personal expression also matched the learning process in *KC*. *ScienceKit* affords the free sharing of media, *in situ* during everyday activities, and we posit that this designed affordance can enhance the process of scientizing one's daily life. Imagine instead if a learner had a cooking experience, then had to wait until they accessed their computer, opened their browser, typed in a *ScienceKit* URL, and then typed in some reflections. This type of experience would be very different than the real-time, in the moment, scientizing that learners could do with *ScienceKit*.

In many ways, the affordances and goals of *ScienceKit* aligned with the affordances and goals of *KC*. Understanding this complex alignment helps us also understand the transferability of this study to other contexts, and the limits of our findings. Would *ScienceKit*'s use be as effective in a learning context that places content knowledge acquisition are the forefront? This question is not addressed by our work. However, any future research that considered such a focus would be best served to ask whether a particular social media tool was designed and positioned to foster the learning behaviors most related to the targeted content knowledge. We also note that we used *ScienceKit* within a bounded network of a few children. If *ScienceKit* were a wider, public social network, would this influence our learners' behaviors? While our study cannot answer this question, we posit that this change in context would undoubtedly alter the learning behaviors that might occur based on prior work (Lantz-Andersson, Vigmo, and Bowen 2013). In addition, we implemented *ScienceKit* with preteen children, who were yet to be avid users of popular tools such as *Facebook*™. The use and effects of social media on child populations is still a nascent, but growing need in the research literature (Grimes and Fields 2012). However, one could also ask whether the learning behaviors seen with *ScienceKit* might have differed with high school teens or college students who are already likely to be enculturated into other social media platforms. Our study demonstrates how a more nuanced reflection on social media and its role in a broader sociocultural context of learning, helps us better articulate when and in what conditions social media may enhance or hinder the learning process.

The second contribution of this work is illuminating how social media can enhance learning in practice. Keeping in mind the context and pedagogy (e.g., the *KC* environment), and the explicit design of the technology tool

(*ScienceKit*), we observed several phenomena that better demonstrate how social media can enhance a learning process. We observed how ubiquitously recording and sharing artifacts in *ScienceKit* helped learners develop different elements of their scientizing dispositions. Learners often recorded observations, posed questions, and devised explanations for the phenomena they experienced in their cooking. Furthermore, we observed learners continually perusing, searching through, and using their artifacts to show their developing conceptual and procedural understanding.

We observed how this recording and sharing practice intersected with *KC* activities to amplify personal interests, social interactions, and personal connections between the children, facilitators, and the science learning experienced in the program. Learners captured ideas with *ScienceKit* during breakfast (Vignette 1), tested out their skills in making observations, but more importantly personalized this practice to their interests. In the group discussion (Vignette 2), there were times when the children were not particularly energetic about making observations and talking about their cookie experiments. However, learners nevertheless attended to the discussion by recording particular pieces, snapping pictures, or creating drawings related to the discussion. In short, they used *ScienceKit* to create personalized connections to an otherwise dull conversation. Subsequently, in an exciting moment of the demonstration (Vignette 2), the learners used *ScienceKit* to get close and personal with the experiment, record friends and the chemical reactions, and engage in social talk and explanation around *ScienceKit* artifacts. The high level of energy and activity arose from the interaction between the learning activity and *ScienceKit*'s affordances.

We were particularly struck by other consistent themes in this implementation of *KC* and *ScienceKit*. Learners often used *ScienceKit* to document their experiences and learning with very little modeling from facilitators, and often without prompting. As learners and facilitators looked at *ScienceKit*'s newsfeed of entries, these entries frequently became artifacts around which we could develop personal relationships with one another. The learners' entries also became persistent artifacts that they returned to in their personal reflections, and used as personal evidence, as they described themselves as chefs, scientists, and investigators in the program. Our experience with *ScienceKit* and *KC* highlights the subtle, but profoundly important ways, that ubiquitous personal sharing can be used to amplify and enhance learning processes for disposition development.

Finally, this study also highlights the potential affordances of social media for educators. Social media tools offer educators a potential means to see learning-in-action, through the eyes of the learner. As facilitators in *KC*, we were able to observe what the children were choosing to attend to as they recorded aspects of their *KC* experience. We often had a difficult time noticing whether quiet and reticent learners were engaging or progressing in the program during face-to-face interaction. However, *ScienceKit* afforded capturing learners' observations and experiences in the moment, which could provide an educator with a real-time feed of information upon which to act. Entries in *ScienceKit* allowed for other channels of discourse, be it the ability for facilitators to socialize and connect with learners through their playful artifacts, or an opportunity to help model scientizing behaviors for learners as they shared their observations and thoughts in *ScienceKit*. Not only can we potentially see how learning is enacted via social media technologies, but we can also have an archived record of it that can be capitalized on during shared learning situations.

We argue that data gleaned from social media tools – when framed and leveraged in a particular way by educators and learners – allow for a unique type of *noticing* in real-time, which could help educators better understand individual learners, respond to them in more effective ways, or facilitate more cohesive collaborative processes between learners themselves. However, this potential can only be realized through a nuanced thought process. Our experience underscores how the design decisions made with a technology affords and constrains potential learning actions (e.g., our decision to develop and utilize a social media tool). The design of a learning situation with its embedded goals, norms, and pedagogy imposes its own set of affordances and constraints. The intersection of these two facets combine with the funds of knowledge and experiences that learners bring to the situation (Calabrese Barton and Tan 2009), and give rise to potentially new learning behaviors. In our case study, we show the unique ways in which our learners' social dispositions were amplified through social media, the importance of these social interactions in learning environments, and the potential of social media to help educators notice learners in action.

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Note

1. Learners often used 'scope' to refer to the process of investigating.

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Appendix. Chemistry background for Vignette #2

Baking soda is composed primarily of sodium bicarbonate (a base). At high temperatures (38°C or greater) (Keener, Frazier, and Davis 1985), the solid sodium bicarbonate ($NaHCO_3$) breaks down to carbon dioxide gas (CO_2), a solid salt (Na_2CO_3), and gaseous water (H_2O). In contrast, baking powder is primarily made of sodium bicarbonate and a weak acid (typically tartaric acid, also known as cream of tartar). When the weak acid in the baking powder reacts with the sodium bicarbonate, the reaction also produces carbon dioxide gas, solid salt, and gaseous water. Both the thermal decomposition and the acid–base reaction can occur in baking powder for it to leaven dough. Adding in the cream of tartar (tartaric acid) allows the sodium bicarbonate in baking soda a chance to react further in a similar acid–base reaction.