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Collaborative Online Inquiry: Exploring Students' Skills in Locating, Reading, and Communicating Information

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Abstract

This study examines third, fourth, and fifth grade students' reasoning that was captured as they engaged collaboratively in a teacher designed inquiry task. This task focused on choosing eco-friendly toys for a fictitious local toy store. Results indicated that students were more expressive with reasoning when they shared their ideas orally, but were less apt to include reasoning in their digital writing. This pattern of results suggests the benefits of pairing talk with writing, grouping students to work collaboratively during online inquiry, and teaching ways to construct digital writing that supports the inclusion of hyperlinks, the integration of images, and other means of connecting digital reading and writing. These digital affordances provide tangible ways for students to include reasoning and evidence within their writing and can bolster their persuasive and argument writing. Recommendations for instruction are offered as well as design considerations for online inquiry tasks.

Ms. Jackson pairs students together for online inquiry, an instructional practice where students investigate a topic of interest to them online aided by teacher and peer support. She provides targeted guidance to improve the quality of their collaboration. She encourages Bridget and Jacey to each share their thinking aloud before writing their ideas down in an email. This process of rehearsal enhances productive collaboration and promotes more detailed reasoning. Ms. Jackson's prompts help her students reflect and encourage higher-level thinking in the moment. "I like reading online and writing with you, Jacey, we talk about what we find on the websites together and it helps me decide what to put into the email," Bridget shared. "I like working with you too, Jacey," Bridget replies. "You remind me about adding links in the email to what we read online so we can explain our reasons."

Ms. Jackson supports her students' emerging digital literacy skills by providing opportunities for the students to explore online content. From the days of Oregon Trail and the first WebQuests, teachers like Ms. Jackson have worked to use technology to encourage curiosity and exploration that seeks to engage students in productive dialogue as they explore online topics of interest to them. Teachers have long used the inquiry process – one where students develop questions and explore several kinds of resources to find answers – as a method for engaging elementary aged learners. Drawing on our experiences designing inquiry tasks (Sekeres, Coiro, Castek, & Guzniczak, 2014) and analyzing students' dialogue (Coiro, Sekeres, Castek, & Guzniczak, 2014), this article demonstrates how structured online inquiry, together

with peer collaboration, can be used to bolster students' digital literacies. In this article, we first introduce how third, fourth, and fifth grade students engaged in reading, reasoning, and collaborative online writing. Next, we show ways that students made use of digital affordances to enhance their reasoning. Finally, we make recommendations for instruction that supports collaboration and builds students' emerging digital literacy skills.

Increasing Digital Access in Schools

As schools' access to hardware and the Internet have improved, educators are faced with the challenge of designing learning experiences that expand students' access to the online world in ways that help them build a set of flexible skills and strategies. Engaging students in online inquiry, and scaffolding their attempts to navigate and make sense of the online world, is a promising instructional practice for achieving these aims (Dobler & Eagleton, 2015; Sekeres, et al., 2014). Current research shows that:

- 77% of teachers indicate that use of digital devices enhances motivation for learning (EdTech, 2013).
- 76% find that they help to address diverse learning styles (EdTech, 2013).
- 58% percent of middle school students and 42% of high school students report using tablets regularly in their classrooms (Pearson, 2013).

Computers have become more available, but are students prepared to use them?

Despite the increasing availability of computers and Internet connections in schools, and the pressure on teachers to use them, students' digital literacies are not assessed (Castek & Coiro, 2015) and are, thus, often inaccurately estimated. In the absence of assessment tools to determine students' digital literacy skills, some educators believe that students' have more advanced skills than they actually possess, which can lead to teachers requiring students to accomplish tasks that are not yet within their control. Other teachers may be reluctant to provide class time for Internet exploration out of fear that the time spent reading online can be frustrating to students who have underdeveloped searching skills (Henry, 2006). We have found that when opportunities to engage students in online inquiry are carefully designed, the results can be instructive for students and informative for the teacher as well. For example, inquiry tasks can be designed with built-in scaffolding teachers can implement to implement to enhance the study of curricular topics. The use of a customized search engine for narrowing down the website choices students encounter as well as offering email starters for writing are both tangible ways to support students as they engage in online inquiry.

In the sections that follow, we discuss how structured online inquiry, together with peer collaboration, were used to bolster students' digital literacies and provide a useful means of investigating curriculum related topics. Moreover, we discuss how observing students while they engage in inquiry activities can yield valuable information about their online reading and writing. The support teachers provide through prompts can encourage higher-level thinking in the moment and serve to further develop students' digital skills so they can be used flexibly.

Study Design

To examine what occurred when students worked in pairs to read and write online, we structured an online inquiry task (Alberta Learning, 2004) for third, fourth, and fifth graders during which they examined background information for the task, searched for new information, and composed an email sharing the results of their inquiry. More specifically, they were asked to

work in pairs to find and recommend toys for an environmentally friendly, though fictitious, Green Toys Shop. They emailed their findings and reasons for their choices to a fictitious manager in order to persuade her to offer these toys for sale in the shop. This study was designed specifically to generate observable data in the form of screen capture and audio streams that allowed us to examine online reading, digital writing, and collaboration.

Participants. The students who volunteered to participate in the study were 16 pairs of third, fourth, and fifth graders who attended a magnet elementary school in a mid-sized southeastern city. The school taught an International Baccalaureate curriculum; thus, researchers designed the inquiry task to dovetail with students' thematic studies that included environmental topics. The task implicitly asked students to examine environmentally friendly toy manufacturing materials, processes, and products. Researchers from different universities around the country chose to study upper elementary students in order to extend previous research about social and cognitive interactions and the role of collaborative dialogue in completing online inquiry tasks. The original research was completed with 7th grade students (Castek, Coiro, Guzniczak, & Bradshaw, 2012; Coiro, Castek, & Guzniczak, 2011; Coiro, Castek, Guzniczak, & Bradshaw, 2011).

The elementary students in this study were able readers. Reading on grade level was one condition of their attending the International Baccalaureate school where the study took place and was also a condition for participation in the study. Within this study, there were near equal numbers of boys and girls who were both white and African American. None of the students were English language learners. Each of the children had varying degrees of experience working with other students to complete online tasks and their experience working on computers in the online environment also varied (although none had any hesitancy approaching the task). Since collaboration in pairs was a design feature, the researchers asked teachers to pair the students purposefully (e.g., students who worked well together) prior to their arrival at the computer lab. Pairings were mixed between gender and race. The inquiry took place across two sessions lasting about 30 minutes on different days, but within the same week.

Task design. Researchers prepared a customized search engine populated with websites that included a variety of webpages that featured information on the environment, toy manufacturing, and "green" toys. The sites were not specifically written for children; about 70 web sites were included. Researchers prepared a task description and directions that explained what students would do within the two sessions. First, dyads were asked to read and think aloud while they navigated the introduction page with several embedded links that familiarized them with environmentally friendly manufacturing materials and processes. Then, these student pairs were asked to find environmentally friendly toys to sell in the shop. Finally, they were asked to report their choices and explain their reasoning in an email to the shop manager. The researchers provided examples of email starters the students could use or they could construct their own way of expressing their ideas.

We report the results of closely observing the students' dialogue, focusing on both social and cognitive interaction during their background reading and subsequent online searching. In particular, we reference the students' use of reasoning in their oral discussions and examine how they used digital affordances available within email to communicate and co-construct responses and share their recommendations. The research questions guiding this study were: 1) What do students discuss during an online inquiry task? 2) How do students provide evidence for their choices of toys through discussion or writing? 3) How do students' discussions correspond with their writing when they report their findings? 4) How do students use digital affordances

available in email to express their findings? We pose these questions to examine the content of students' dialogue in relation to their writing and examine how they used digital affordances to express their choices and provide evidence. Examining these processes in detail provides us with opportunities to discuss students' strengths and weaknesses and to explore instructional supports to build their collaborative dialogue, online reading, and digital writing skills. Patterns of results may guide teachers as they consider how to design inquiry tasks that are both supportive and build students' independence with online reading and writing. It is our contention that using collaborative inquiry in classrooms can help to deepen students' engagement with content. Also, it can encourage the purposeful use of Internet and digital devices in ways that enhance students' higher order thinking and collaboration skills as well as their reading, writing, and digital literacies.

Literature review

We know that good readers actively apply a limited set of metacognitive and social reading processes (Palinscar & Brown, 1984; Pressley, 2000) before, during, and after reading. They also thrive in social, inquiry-based opportunities to explore areas of personal interest (Guthrie, Wigfield, & Perencevich, 2004). When exploring online resources, many literacy processes are similar. However, due to the extensive amount of material encountered online and the many choices readers have to navigate through it, an expanded set of literacy strategies are needed to navigate online information (Coiro & Dobler, 2007). Previous research with seventh graders indicated that students benefit from completing online inquiry tasks collaboratively (Coiro, Castek, & Guzniczak, 2011) and engaging in before-reading activities such as overviewing the task and planning their work (Coiro, Castek, & Guzniczak, 2011; Coiro & Dobler, 2007). During reading, students read responsively, co-constructing meaning as they read and navigate online text and links together (Afflerbach & Cho, 2010). Good readers construct cohesive summaries, reflect on information, and use it for some purpose. These collaborative literacy processes are supported by the Common Core State Standards (National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010) that call for learners to be skilled at close reading and meaningful discussion. They must be able to construct meaning across multiple, complex, and multimodal texts that are largely informational. We believe that engaging students in inquiry-based offline and digital research practices that are framed by inquiry while working collaboratively can help meet these standards, strengthen their digital literacies, and increase engagement in learning.

When readers are conducting online research, they are able to engage in iterative and overlapping cycles of questioning, locating, evaluating, and synthesizing information (Leu, Kinzer, Coiro, & Cammack, 2004; Leu, Coiro, Kinzer, Castek, & Henry, 2013). Proficient online learners apply constructively responsive reading strategies (Afflerbach & Cho, 2010; Pressley & Afflerbach, 1995) in ways that enable them to co-construct the texts they build together and co-construct interpretations that result from their interaction (Sekeres, et al., 2014). This suggests that the discussion that ensues during online reading helps students process and comprehend information, which can have a direct impact on the reading they engage in, the decisions they make in response to the task, and the reasoning they discuss and include in their writing. While the studies reviewed here provide us some information about students' online reading, little is known about how they collaboratively make choices about what to read and how they share experiences and connections to their background knowledge to inform those choices. The current

study provides data that examines students' online reading, discussion, and writing as they collaboratively engage in structured online inquiry to respond to a teacher-designed task prompt.

Online Writing

Writing instruction has profoundly changed since the introduction of the word processor in classrooms in the 1970s. Just as the web has enabled more collaboration and interactivity through blogs, Google docs, VoiceThreads, and other more socially driven digital writing tools, there has been a pedagogical shift away from individually constructed, and somewhat isolated, writing activities toward the social processes that writing technologies have enabled over time (Cochran-Smith, 1991). To make the best use of the affordances of new technologies, instruction needs to make use of the many capabilities of digital devices and online resources (Cochran-Smith, 1991; McGrail & Davis, 2011; Sun, Yang, & He, 2014). Reading and writing online is also important for building students' communicative expertise. For example, students engaged in blogging were exposed both to "readerly" work by attending to their readers' needs as they wrote their own blogs and to "writerly" work as they read through others' blogs and critiqued them. Pairing digital reading and writing together improved their skills in both areas (McGrail & Davis, 2011; Swenson, Young, McGrail, Rozema, & Whitin, 2006).

Providing opportunities for students to write collaboratively and communicate to others outside of the classroom gives them access to an audience that may include business people, academics, service workers, and others around the globe. This expanded audience highlights the important use of conventions that provide organized, coherent, and understandable messages. The affordances of online writing also allow students to use multimodal expressions in their writing, including "linguistic forms, as well as visual, audio, gestural, and spatial forms and patterns" (Black, 2005, p. 122). In an online format, students can include hyperlinks in their communication that provide their audience with more information should they choose to access it (O'Brien & Scharber, 2008). Emoticons or other paralinguistic features in online writing add character and style (Black, 2009), but also provide a means of expressing preferences and drawing attention to important ideas.

We know that writing instruction is more effective when it includes interdisciplinary, thematic, and technology enabled approaches. For example, Warren, Dondlinger, & Barab (2008) showed that games can help students improve their writing when writing tasks are built in as requirements for advancement in the game or are included as game-like tasks that are asides to the narrative structure.

MacArthur (2009) noted that questions about instructional design are key to the study of using technology to support writing. Components of instructional design include the design of templates and other supportive features for how to integrate writing instruction with reading for information (p. 99). As a result, students are better able to use digital tools to co-construct and share online what they have learned with others (Castek, Beach, Cotanch, & Scott, 2014). The goal is for students to effectively use the Internet to publish writing that examines a topic, conveys relevant ideas, and cites sources (National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010). These studies highlight the importance of teaching digital writing skills to students as a means of enhancing their ability to communicate. The present study confirms and elaborates our understanding of how students use digital writing to communicate their reasoning when making particular choices to complete a task that involves digital reading and accessing online resources, such as images.

Integration of Online Reading and Writing

A primary focus of writing research has been the importance of integrating reading and writing instruction (Shanahan, 2006). Students are often encouraged to use writing to formulate their interpretations of texts and also to share those interpretations with others. The ability to formulate valid insightful interpretations, in turn, requires reading comprehension strategies that go beyond simply restating or summarizing texts. Students who are effective readers of books and magazines may not necessarily be good readers of digital texts (Leu et al., 2011). In reading digital texts, students are involved in locating key information on a page, identifying a site's source or author, navigating across different pages, making inferences across intertextual links between pages, synthesizing ideas, and critically evaluating the content they come in contact with online. Familiarizing students with the features digital authors use as they connect and communicate ideas demonstrates a menu of digital options that are open to students as they compose ideas digitally. Writing instruction that encourages writers to make the most of digital affordances such as the inclusion of images, hyperlinks to source information, and providing a trail of reading activities through the use of a digital archiving can be useful ways to help students make tangible connections between their reading and writing. While connecting digital reading and writing appears to be a beneficial instructional approach, few studies have explored the ways teachers have structured activities to solidify these connections.

Methods

Students in the current study were asked to respond to a teacher-provided task that involved personal choice at several levels – what to read, what to search for, and how to frame their rationale in writing. Within the task design, students read some background information that informed their choices while searching and helped them make connections to curriculum topics they previously learned. Ultimately, students were asked to make choices that were shaped by the context of the task, as well as the time they had available to complete their work.

Data Collection

The larger study from which this article is drawn had several data sources, including content-knowledge and technology use pre-tests. This article narrows the focus to the two sessions that students spent in the computer lab actually working to complete the task and their responses to a post-session interview. Data presented here were collected from 32 students who were organized into 16 dyads: four dyads from third grade, five dyads from fourth grade, and seven dyads from fifth grade. During the first session, students were invited to explore an introductory information page where they could read about terms related to the manufacturing of toys and concerns about potentially harmful materials. The page had several embedded links, such as "PVC plastic", "biodegradable materials", and "solar power", that the researchers encouraged students to explore (see Figure 1). Students were asked to talk aloud as they read and worked together and to verbalize their thoughts and questions. They were encouraged to discuss whatever they chose. Researchers planned for students to take 20 minutes to complete the first session; some students did little more than read, although others talked about every concept on the page, taking more time. Screen-captured videos recorded students' onscreen navigation and reading, face-to-face discussions, and verbal and nonverbal interactions with the text and each other.

Eco-Friendly Tips About Toys

Garbage is a huge problem because it consumes resources, pollutes our planet and doesn't ever go away.

How can toys pollute the environment?

- Many toys are made of plastic that can cause pollution because they leak dangerous materials into the water and the air when they are thrown away.
- Toys that need batteries to make them work can cause pollution because chemicals like lead or acid leaks out of them and into the ground.
- Some toys are painted with paints and dyes that are made with harmful chemicals.
- Many toys are wrapped in a lot of packaging materials that are thrown right into the garbage after they are opened. These materials take up space in landfills and litter the ground for hundreds of years.

Eco-friendly toys are toys that do not harm the environment when they are made or when they are thrown away. What can you do to help choose eco-friendly toys?

- Don't buy anything that is made of PVC plastic. Choose toys that are made of natural or biodegradable materials that will not damage the earth.
- Look for toys that are solar-powered instead of toys that use batteries.
- Look for toys made of unpainted, solid wood and finished with tung oil or beeswax.
- Choose toys that are solidly constructed and will last long enough to be passed on to younger children, such as

Figure 1. Illustration of the teacher provided webpage designed to increase students' background knowledge of eco-friendly materials.

During the second online session in the computer lab, students were invited to look for three toys to offer for sale in the Green Toys Shop. They were reminded that they would be asked to write an email with reasons for their recommendations at the conclusion of their search. They were also reminded to verbalize their thinking and reading. After about 20 minutes searching for toys, they were asked to write the email, which took a varying amount of time for different dyads—from 5 to 20 minutes.

Data Sources

Researchers watched and transcribed the video screen captures of the two online sessions for each dyad and met frequently via video conference to discuss their observations prior to beginning the coding process. The video screen captures were collected using Camtasia. The video screen capture allowed researchers to examine navigational information of what students were viewing on the screen, the links they followed, and how they conducted their search. The screen captures also included a head shot of the students as they worked, which provided information about how students positioned themselves as they collaborated as well as their facial gestures as they reacted to the text and each other. During the coding process, transcriptions of students' dialogue became the main data source used to analyze their interactions as they read and constructed emails while gestural and positional information were used as secondary data sources. Students' composed emails and their interviews were used as additional data.

Data Analysis

A team of researchers, consisting of four professors from different universities and four graduate students, completed the data analysis. Using strategies developed from earlier studies (Coiro, Castek, Guzniczak, & Bradshaw, 2011; Coiro, et al., 2012; Sekeres, et al., 2014) that used video analysis of students working online, researchers first reviewed the videos for a general sense of the students' interactions (Tesch, 1990). After videos were transcribed, lines of students' dialogue were coded using a previously defined coding scheme from the earlier studies. Researchers identified two processes used in student discussion: cognitive processes (such as planning, questioning, or interpreting and social) and collaborative processes (such as giving directions, requesting clarification, or providing a judgment).

Researchers then coded the transcribed conversations by topical episodes to characterize typical patterns each dyad used to read, talk, and think together during the time spent reading and writing for the online inquiry task. The episodes generally reflected students' shifts in topics of discussion, which were often triggered by navigating to new web pages. The summaries of the topical episodes enabled researchers to compare and contrast patterns of cognitive and social interactions across dyads and grade levels, which led to the formulation of potential common dialogic profiles that would be useful for instruction. Finally, aggregated codes were plotted on a researcher-designed rubric that combined the cognitive and collaborative codes to create a continuum of the students' use of cognitive and social strategies in their reading and writing collaborations. The results were three discernable groupings of students along a continuum consisting of Readers, Talkers with lower-level thinking, and Talkers with higher-level thinking (see Figure 2). These three categories were based on how much conversation occurred between the students, as well as the quality of that conversation. The categories also described the cognitive and social strategies students used during their talk. See Table 1 for examples of the kinds of talk each of the three categories represents. The side-by-side examples of students' discussions as they navigated the introductory page that was meant to activate background knowledge revealed the complexity of some discussions. In other dyads, the focus centered on surface issues of understanding the task itself.

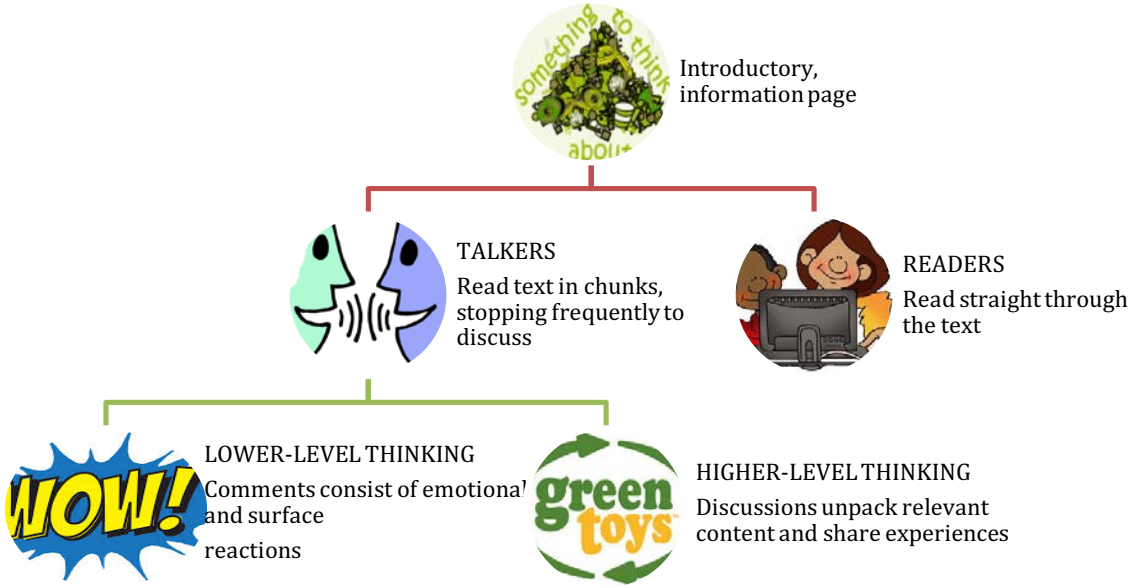


Figure 2. Patterns of collaborative thinking.

Table 1.
Examples of Talkers' and Readers' dialogue

Talkers with higher-level thinking	Talkers with lower-level thinking	Readers
While reading a list of harmful and eco-friendly manufacturing materials, Priscilla and Trish, third graders, grappled with the ideas in the text:	Reading the same list, Patty and Darren, fourth graders, have a lower-level conversation that pauses at a topic, identifying ideas but not exploring them:	After reading through nearly the entire page, including links, without pause, this is a longer conversation about products made of plastic between Cynthia and Andrew, fifth graders, with a short exchange of ideas:
T: (reading) *Don't buy anything that is made o fP, P,* ugh, *PVC plastic*. P: PVC is something like a polymer thing. Well, they can like degrade. They can't like degrade into the earth. They stay on top of earth. Hey I think, yes, Garbage is a huge problem (clicks link) P: Oh my gosh, sorry. We can go back. (Clicks Back) P: (reading) *Garbage is a huge problem because it consumes resources, pollutes our planet, and doesn't ever go away.* P: Oh, no! T: Well plastic do. Because when you like sit it out for a long time… P: Oh yeah. T: …it goes into the surface. P: Yeah, but that means that they are biodegradable. They can degrade into the earth. But something like gum can't. T: Yeah, it just sits there.	D: (reading) *Look for toys that are solar-powered instead of....* P: Ooooh. D: Yeah, we talked about that last year. D: (reading) …*solar-powered instead of toys that use batteries*. P: That would be really, really… D: So, basically it's like a toy like has like a solar power on the back of it. P: Yeah, that would be so cool! D: That would be awesome. (clicks link) P: Oh wow. D: We know what solar power is actually. P: Yeah. That would be so cool. (clicks to return to previous page) D: That would be awesome.	C: What is that, Evenflo? A: Gerber. C: No, I don't know what Evenflo is. I know what Gerber is. A: You said Jerber. C: Oh, I meant to say Gerber.

Of particular interest for this research were the transcriptions of the dialogue of the Talkers with higher-level thinking. For example, those who verbalized much of their thinking, discussed the reasons why particular toys were more interesting or more environmentally friendly. In some cases, Talkers sparked some memory that the students valued. Some of their discussions were complex, weaving together their new knowledge gained through the act of

reading, while in other cases, students drew on their previous studies of environmental issues and their own experiences with toys. Talkers with lower-level thinking engaged in reading and talking, but the talk centered on turn-taking and task directions or emotional reactions to the text. Readers' discussions were less frequent and less involved and their talk focused almost exclusively on reading aloud the text with little or no interaction.

Findings and Discussion

The patterns of dialogic interactions uncovered during data analysis had interesting correlations to the information the students eventually chose to include in their emails that summarized the reasons for their toy choices. Dyads fell into two very broad categories of interaction. The first group of students, who we named Readers, primarily spent their time simply reading; they talked little, sometimes only to be polite, and did not discuss what they were reading, nor did they question the text or relate it to their experiences, as other dyads did. While these students stated they found the task interesting and would like to do more of it, the data showed that they made fewer connections to the content. Their dialogue gave us few indications of how they cognitively processed their reading, made choices, or constructed the reasons for those choices. Because there were fewer collaborative instances of dialogue, they also did not demonstrate extensive collaboration during the task. For this group, we gleaned insights from their email products and post-task interviews.

The second group of students, who we named Talkers, were those who discussed almost constantly while they read. Analysis revealed that they engaged in relevant conversations and made connections that enhanced the meaning they brought to the tasks. During their reading and discussions, we found that these students often noted environmental issues, such as the dangers of using PVC in toys or the reasons why a particular toy could be considered eco-friendly or not. While several dyads discussed eco-friendly materials and used this information as the basis of their choice of toys, not all dyads included this information in their emails, indicating a lack of carryover from reading to writing. In the section that follows, discernable patterns within the group labeled Talkers are discussed in relation to their collaborative online reading, face-to-face discussion, and digital writing.

Student interactions that were representative of higher-level thinkers consistently engaged in strategic meaning-making processes, including determining important ideas, integrating, clarifying, evaluating, and monitoring information they encountered in their online reading. Those students were also more able to integrate both partners' contributions to formulate a well-rounded conclusion. Dyads from all grade levels were represented in the category of talkers, both lower-level and higher-level. Third grade dyads were evenly distributed across the two categories, while fourth grade and fifth grade dyads each had slightly higher participation in the higher-level category. In the following sections, we explore the differences in the patterns of dialogue that exemplified lower-level and higher-level thinking. We then go on to show the connection between higher-level and lower-level thinking to the students' email writing.

Patterns in Dialogue: Talking as Lower-Level Thinking

Fourteen of the dyads were coded as Talkers; six dyads' talk was coded as revealing lower-level thinking during most of their discussion. Codes for these students indicated several instances of task planning, navigating the online space, clarifying task directions, and figuring

out how to pronounce words. They reacted emotionally to the text or each other, suggesting interest in the toys but lacking a connection to eco-friendly themes that the task required. While these students successfully compiled and communicated toy names, their reasoning for their choices was absent. The excerpt below provides an example of lower-level thinking from a third grade dyad, Ashley & Cecile. This excerpt is taken from their reading about PVC plastic, one of the topics that was included on the background knowledge-building web page. The italicized font in the excerpt indicates reading text aloud from the web site.

> Cecile: *It is a seemingly indispensable material that could be deadly, especially when it burns.*
> Ashley: Whoaow! OK!
> Cecile: I don't think I like Toys R Us (gets a look from Ashley). What? I don't want to burn my house down by playing with toys.
> Ashley: OK.
> Cecile: *Bi*... Wait, what is…? How do you say that? (points at *Biodegradable*) How do you say that?
> Ashley: *Biodegradable*
> Cecile: OK.
> Ashley: What does that mean?
> Cecile: I have no idea.

The dyad continues without further exploration of the meaning of the word biodegradable and makes no effort to use resources to further explore or unpack the concept. The result is a lower-level discussion that reflects acknowledgment of new information, but no action taken to resolve the confusion. Dialogue such as this resulted in students providing a list of toys that was absent of reasoning connecting to eco-friendly materials.

The second example of dialogue is taken from the part of the task when the students were asked to search for eco-friendly toys. They had typed the term *eco-friendly toys* in the search bar of the custom search engine described earlier and were looking through the list of websites that resulted.

> Ashley: (reading search results) *Eco friendly toys.*
> Cecile: Oooo. Doll houses.
> Ashley: Click on that one. OK, there.
> Cecile: So, OK. Um…
> Ashley: OK but do not buy anything.
> Cecile: Yeah that wouldn't be the best thing.
> Ashley: Um…Go down. Scroll down. Use the scrolls.

The students continued to skip through the search results, responding to what they saw in an interested, but less thoughtful way. While this dyad was engaged in reading and talking, their discussion was less productive in terms of making sense of the eco-friendly concepts in the text and making decisions about which toys should be offered in the toy shop using the information they read and discussed. Working with this dyad to help them more deeply engage with eco-friendly themes and prompting them to share connections to their background experiences, as

opposed to just reading and reacting, would help them make more informed choices that could be supported with reasoning.

Patterns in Dialogue: Talking as Higher-Level Thinking

Some dyads talked productively and used their discussions to make connections to eco-friendly themes and their own background knowledge. These groups of students actively constructed meaning due to the content of their dialogue, which allowed them to make inferences beyond the text, integrate information across reading materials, interpret ideas found in the text, question relevant concepts, and evaluate the quality of the information they read. The following example is from a fourth grade dyad, Barbara and Tim. This excerpt is taken from their collaborative dialogue about ideas found on the background knowledge page the researchers provided to prompt the inquiry. As they read, this dyad discussed several points about materials that were harmful and those that were not harmful, specifically PVC plastic, batteries, paints and dyes, packaging, recycling, and cotton. Before they completed this portion of the task, they decided to make a list of the points they wanted to remember for their search, to be completed in the future.

> Barbara: I think we can put…
> Tim: Biodegradable.
> Barbara: (looks back at webpage) Something on there.
> Tim: Biodegradable is good. (writes)
> Barbara: Yeah. Wait, hold on. (reads from webpage) Didn't it, what did it say about… *it is also PVC and phthalate-free*. Oh, ok, yeah so it doesn't have any of that stuff in it. (writes)
> Tim: Yeah, that's good. (looks at webpage)…It can be wood, look. It can be wood.
> Barbara: (re-reading) *Look for toys that are solar-powered instead of toys that use batteries.* Solar-powered that would be like, you know, it's like powered by the sun, so it doesn't, so it won't leak or anything. So it won't leak onto your floor or do anything because it will be powered, powered by the sun.
> Tim: *Choose toys that are unpainted*… (writes)
> Barbara: Mm hm.

This dyad continued to check the webpage and add to their list items such as solid wood, recyclable materials, and cotton or wool. They reminded themselves that wood blocks and Teddy Bears would be good choices, based on these requirements. Their talk was characterized by checking with each other to either determine or confirm what the ideas they read about meant in relation to toy choices, passing back and forth control of the search, planning together what their process would be, and sharing in the writing process. These students used both high-level cognitive strategies and collaborative strategies to move their inquiry forward.

The second excerpt, from their search, shows their process of choosing toys while maintaining a focus on the important idea of eco-friendly materials.

> Barbara: Wait, hold on. Let's look over here.
> Tim: This is ecofriendly.
> Barbara: They don't, they don't have, do they have plastic, PVC plastic?
> Tim: Uh, no, I don't think so.

Barbara: I think they'll have something like, no, I don't think that. They don't have batteries.
Tim: No.
Barbara: Um, it's not glass, and it…
Tim: I don't think there's paint.
Barbara: I think it's like pictures maybe, like coloring.
Tim: Yeah.
Barbara: I think it's like a… So down here we can put the stuff that we wanna get.
Tim: Yeah.
Barbara: So 1 stuffed animal. Right?
Tim: Right, uh, so stuffed animal and trading cards.

In this abbreviated discussion, we see the dyad double checking their list of materials that are environmentally friendly and recalling those materials that they wanted to avoid in their final choices. Interestingly, Barbara and Tim logged more lines of dialogue than lines of reading overall, as was typical of more productive talkers, indicating perhaps ways that productive collaboration can intersect with social engagement.

Correlations in Reasoning: Reading, Discussion, and Writing

As part of the task requirements, dyads were asked to complete the inquiry by writing an email to the fictitious manager of the Green Toys Shop. In the email, they were asked to tell the manager what toys they thought would be good sellers and why they suggested those particular toys. They used information from their reading about eco-friendly materials as support for their suggestions. Asking students to compose an email provided us insight into their decision making, reasoning, and ability to communicate their choices and evidence for those choices to an audience outside the classroom. Not all of the eight higher-level thinkers included the reasons that developed through discussion in their digital writing. However, 5 of the 6 the emails that showed substantial environmental reasoning for toy choices were written by higher-level thinkers. The reasons that students included in their emails fell into four categories: 1) no reasons given, 2) suggestions for how the toys might be used or why boys and girls would like them, 3) an unsupported statement that the toys were eco-friendly, and 4) specific, environmentally-safe characteristics of the toys listed.

Many of the dyads discussed the different toys they found in their search and incorporated reasoning in their emails, however the quality of the reasoning varied greatly from unsupported statements about them being eco-friendly (with no evidence) to the inclusion of relevant eco-friendly characteristics drawn from a good understanding of their background reading.

While all the dyads should have been able to cite green characteristics of toys using the background reading the researchers provided, there were clear correlations between those who engaged in higher-level thinking and the complexity of their emails. This indicates that perhaps some dyads assumed that saying the toys were eco-friendly was a sufficient reason without having to justify what makes a toy eco-friendly. Several dyads listed how they thought children would use the toys; for example, that a stuffed animal could be used in pretend play as a veterinarian or that children like to make noise, so a toy drum would be a good toy choice.

A few misconceptions from the reading were also revealed in some dyad's emails. One dyad wrote that the toys were made from colored cotton, so there was no need for harmful dyes

(misunderstanding that the yarn had in fact been dyed). Another suggested dollhouses used solar power instead of being made of PVC plastic, which showed that they confused construction materials with power sources.

Eight of the 16 dyads specifically discussed characteristics of the eco-friendly materials in the toys and ways they were environmentally safe in their emails. For example, dyads cited that the materials were biodegradable or were made of cotton fabric, wool fabric, water-based dyes, or unpainted wood. These emails also occasionally listed ways children could use the toys. These dyads' reasoning was linked directly back to aspects of their reading or discussion – the reading/writing connection that the task was designed to facilitate.

Lower-level thinking led to a less informative email. Ashley and Cecile had read through the information page talking about it in surface level ways and their search showed a similar pattern of dialogue (see Figure 3).

Hi, Ms. Gordon!

We wonder when the shop is going to open? Would you be nice enough to let us have a discount because we helped you???? We have some nice toys for you to sell at your new store!!!!!

1. Recycled Plastic Jump Rope The colors include Pink, Green, and Purple
2. Recycled Plastic Fire Truck
3. Early Melodies Pound & Tap Bench

Figure 3. Ashley and Cecile's email to the toy shop manager.

The dyad used a lavender color for the first paragraph and the rest of the text was black. Although they include a greeting, they do not give any context for the email nor do they include a signature. This example indicates that while the students were attending to important and relevant information in the text, some support for productive collaboration is needed to aid them in further discussing the ideas and coming to a decision that reflects a mutual understanding of the content and task requirements.

While there were some collaboration and cognitive strategies that were evident in Ashley and Cecile's interactions, instructing students on ways to productively make use of suggestions from a cooperating partner would further benefit this dyad. In addition, targeting instruction on ways to promote the carry-over of ideas from reading and discussion into writing is also needed. This type of instruction would aid students in bolstering their reasoning and, thus, communicating more effectively their choices.

Higher-level thinking led to a more informative email. Barbara and Tim continued their effective collaboration as they constructed their email. They wrote their email as one might write a letter by including a salutation, the body of the email, a closing, and signatures (see Figure 4).

Hi, Ms. Gordon. We want to help you pick some toys out. We have picked out three eco-friendly toys. The first toy is a stuffed animal. We picked this toy because it is made of cotton, wool, and/or fabric. The materials used do not harm the environment. Our second toy is the Sprig Discover Rig. We picked this toy because it is solid wood, recyclable, and solar powered. The Green esCAPE Playhouse is our third eco-friendly toy. We chose this one because it was made out of solid wood, biodegradable materials, and it is recyclable.

Thanks for your time,
Tim and Barbara

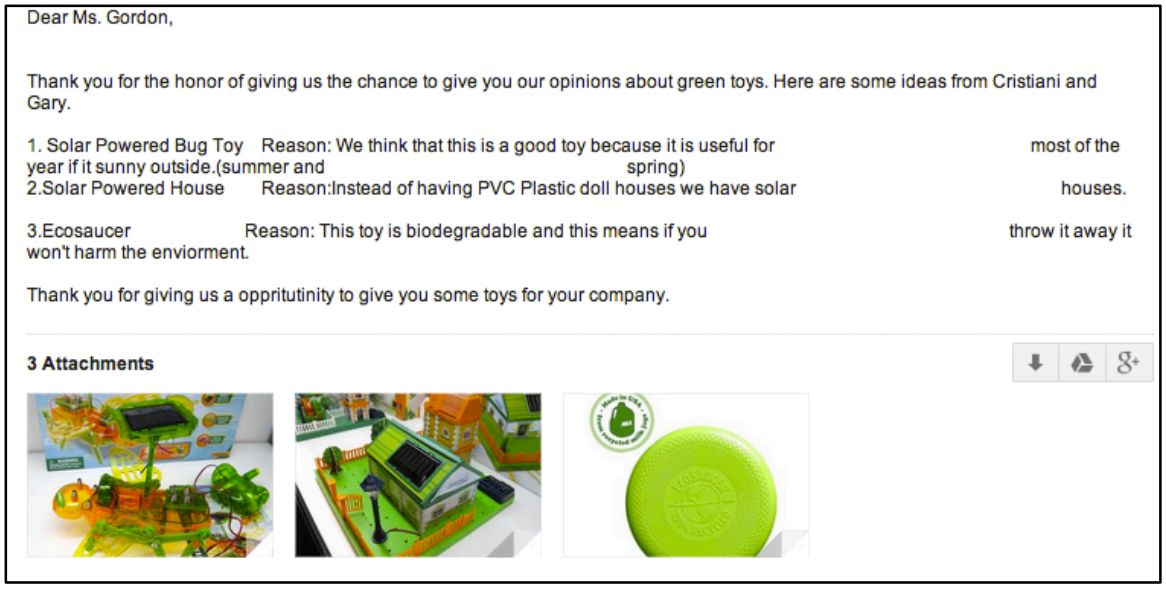
Figure 4. Barbara and Tim's email to the toy shop manager.

Barbara and Tim's email provides the reader with the context for the email, a list of toys, and an environmental reason for each choice. The email provides evidence of their collaborative reading, discussion, and note-taking about the eco-friendly materials and those that should be avoided because of the potential of harm to the environment. The inclusion of details about materials for each toy reflects their careful attention as they worked through the information page and their search.

Students' Use of Digital Writing Affordances

Students did not receive any instruction on how to use the affordances of the digital environment to enhance their emails; however, some dyads used features often encountered in online texts. The example emails described in the sections that follow demonstrated that some students optimized the use of the digital medium to enhance their arguments and provide the reader with additional information. These emails suggest opportunities for instruction focused on digital affordances and indicate ways to introduce digital writing tools to aid students in linking the online reading they took part in with the communication of ideas in their email. Teaching students to link their reading and writing in this way can strengthen their arguments by offering support drawn from their online exploration.

Use of digital affordances: Clear organizational structure and images. Gary and Chris are fifth graders who included images as well as details from their reading to talk about their recommendations for toys. Their persuasive argument for their choices included descriptions of toys that were marked by a distinct numbering of their choices. The organization of their ideas demonstrated a consideration of both purpose and audience. The fact that the images they included linked back to the web page where the toy could be purchased was considerate of the reader's needs because it allowed the email receiver to quickly act on the purchase. In addition, adding images provided supportive reasoning linking reading and writing, and also suggests that students attend to how information is presented online – through the integration of both textual and visual cues.


Dear Ms. Gordon,

Thank you for the honor of giving us the chance to give you our opinions about green toys. Here are some ideas from Cristiani and Gary.

1. Solar Powered Bug Toy Reason: We think that this is a good toy because it is useful for most of the year if it sunny outside.(summer and spring)
2.Solar Powered House Reason:Instead of having PVC Plastic doll houses we have solar houses.

3.Ecosaucer Reason: This toy is biodegradable and this means if you throw it away it won't harm the enviorment.

Thank you for giving us a oppritutinity to give you some toys for your company.

3 Attachments

Figure 5. Gary and Chris' email including images of the toys chosen as a form of reasoning

Claudine and China were fourth graders who provided links to their toy choices within their email. While the inclusion of long URLs might look quite unwieldy within an email, the fact that this digital information was included was considerate to the reader and allowed the reader to access the webpage where the green toy was further described and where more details could be found. In terms of digital affordances, teaching students how to hyperlink to a word so it is not distracting to see the entire URL would be purposeful for email construction and other forms of digital writing. Claudine and China also labeled their toy choices and provided a statement explaining why they chose each of the toys. They have built in specific reasoning language and gave the reader a mechanism for navigating back to the source site. The inclusion of the digital affordances of embedded URLs helped students tangibly link their choices with their reasoning with minimal extra effort.

http://www.hazelnutkids.com//item/HA4631/Haba-Fill-the-Flower-Pot-Game-in-a-Tin/1.html?c=1au Toy1
http://www.hazelnutkids.com/item/KK89064/Kathe-Kruse-Organic-Lamb-Towel-Doll-Pink/1.html Toy 2 http://www.hazelnutkids.com//item/PT51700/Plan-Toys-Wooden-Activity-Cart-disc/1.html?c=1dg Toy 3 http://www.hazelnutkids.com/item/PT5111/Plan-Toys-Happy-Engine-Wooden-Pull-Toy-disc/1.html Toy 4 http://www.hazelnutkids.com/item/CLSTUFFEDbunny/Cate-Levi-Wool-Stuffed-Animal-Bunny/1.html Toy 5
We chose # 1 because, it's easy to clean up and is travel sized. We chose #2 because, it's adorable and is good for teething. We chose #3 because, it's a train and it has an elligent array of colors. We chose #4 because, it's durable and it teaches them how to walk. We chose #5 because, it was so cute and is soft for kids.

Figure 6. Claudine and China's email that includes hyperlinks to images and provides more reasons for toys they chose

Doug and Candy were fifth graders who used a straightforward means of communicating their ideas. They did not make use of digital affordances as the first two dyads did; their email appeared to look as a letter would. They included a subject line, salutation, and a narrative explanation of their choices. Their signatures are their self-chosen pseudonyms, showing their

awareness of Internet safety when communicating with someone they did not know. The way they constructed their email shows they considered the reader's needs and provided the information requested in a respectful and easy-to-follow manner.


Subject line: Toys For the Green Toy Shop
Dear Ms. Gordon,
Thank you for asking us to help you find toys for the Green Toy Shop. We were glad to help. Here are our ideas. We think a Babypouce Pink and Blue Stripe 12" Doll from Corolle would be good for the store. It is made with phtholate-free vinyl and cotton. We also think a BFF Bracelet Starter Kit with 100 Element from Shains will be good for the store, too. It is lead free, uses recycled Thermoplastic Elastomer (rubber), also uses recycled Acrylonitrile Butacliene Styrene (a non toxic recyclable plastic), and recycled paper packaging. This is why it will be good for the store. We also think the Brazillian Hanging Chair Rainbow from Byer of Maine.This contains the materials of cotton and sustainable harvested wood. Those are all of the things we think should go in the Green Toy Shop.
Thank You,
Skittles and Doughnut Shop.

Figure 7. Doug and Candy's email message demonstrated a knowledge of letter writing and incorporated reasoning, but did not make use of digital affordances

The students' reasoning was bolstered through the affordances of online writing in a way that is not possible through paper and pencil and their work also showed creativity in presentation, if not always in organization. Examining students' email construction and reflecting on their strengths and weaknesses in communication helps point the way toward instruction that enhances students' abilities to use digital tools for enhanced writing.

Teaching students how to use digital organization tools, such as Evernote (a digital note-taking app) or Clipmarks (an app that tracks the websites where information has been gathered), offers students ways to archive where they have been online as they gather information. Having at-the-ready an archive of their thinking would assure that their reasons for following a line of inquiry aren't lost in multiple searches. Such tools can preserve and showcase their reasoning as they progress through a task. Likewise, teaching students the mechanics of hyperlinking and image integration in their digital writing provides means of evidence to support their position in communicating the results of their inquiries. It also provides a tangible means of accountability for students' time online.

Conclusion and Implications

Inquiry tasks provide unique opportunities for students to learn the digital literacy skills and strategies they need for effective online communication. However, conducting inquiry learning within the confines of a classroom setting brings with it both affordances and restrictions. For example, the time available for exploration is limited and the ultimate outcome is fixed on the task specific outcome. No matter how structured an inquiry activity may be, the digital environment offers distinct opportunities for choice, customization, and self-expression. We designed this study to examine the ways that students worked both within and outside the confines of the task to follow their interests. We invited them to make use of their previous online experiences and knowledge of the affordances of the digital environment to meet the goals of the task. The teacher also plays a significant role in scaffolding students in the moment and

guiding their collaboration to promote higher-level thinking. This study, and the examples of student dialogue included within it, provide a backdrop for teachers to examine the kinds of verbal and digital interactions that indicate higher- and lower-level thinking. Through examination of these examples, teacher prompts for deeper engagement can be developed and used to support students in-the-moment in order to provide a supportive collaborative environment where student dialogue serves as a scaffold to encourage quality reading and writing. Prompts for deeper interaction (such as *share your thinking with your partner*, *talk out your reasoning before you write*, and *does your partner agree with the direction you're heading in*) can encourage quality engagement and thoughtful interaction with the content and with a partner.

This study highlights several areas that are important to consider when designing inquiry tasks and preparing students to read and write online. The affordances of the online environment offer much to an informed student—the immense amount of information available, the programs that allow one to easily capture websites and keep track of one's work, and the ability to communicate quickly and easily with many other people. However, students need to be discerning in what information they choose to read; thus, teachers need to provide structure for inquiry to capitalize on the advantages and minimize the distractions.

Design Considerations

Authentic inquiry tasks connect students to relevant real-world concepts and events. Thus, we based the inquiry task for our study of students in grades 3-5 on curriculum topics their teachers covered to help maximize engagement as well as capitalize on students' prior knowledge. We structured the inquiry by asking students to find particular answers to our teacher-directed scenario and to move through the given materials by working in pairs. We asked students to read an informational overview webpage we created with embedded hyperlinks to increase their knowledge of environmentally friendly materials so that they could think about why a toy was eco-friendly. The texts we used provided an implicit structure and gave students an opportunity to explore key ideas in more depth. In preparation for an effective inquiry project, students need preliminary exposure to the topics and context in order to formulate questions, be aware of vocabulary they may need to further explore, and have a plan for inquiry. As students learn to navigate webpages, and use multimodal tools, less structure would be appropriate.

The patterns that we saw repeated across multiple partners supported the idea that specific, logistical, and instructional designs can help students work through inquiry tasks in productive ways. A gradual release of responsibility can support students initially as they move toward more open inquiry and their digital literacy skills become more sophisticated. Providing opportunities for students to learn how to collaborate through discussion and planning would be helpful. For example, when students stop their reading or searching periodically and summarize what they have learned or ask questions to clarify their understanding or broaden it, they retain and use information more effectively. Providing strategies for sharing control of the mouse and keyboard, and planning for the work to be completed within time constrictions, helps students navigate both the inquiry task and Internet effectively. Teaching students how the digital environment optimally enables them to create products, can help them expand communications through adding images, links, color, and graphics to their writing. Helping them develop skills to keep track of their thinking, through annotation tools, enables them to use these to track ideas and frame their writing when applicable. The students in our study all felt competent in the online environment; however, it was clear that for some, their beliefs did not match their need for

skills to appropriate the affordances of the Internet and complete their task skillfully.

Instructional Implications

The Common Core State Standards require students to employ technology flexibly to enhance their reading, writing, speaking, listening, and language use. They require students to tailor their searches online to acquire useful information efficiently and then integrate what they learn online from websites and multimodal Internet resources with what they learn offline from classroom activities, books, and other print materials. The standards require students to be able to strategically use technology when writing and editing collaboratively. As students work together in guided inquiry as suggested in this article, they learn to hone their digital skills and refine their abilities to find, evaluate, and synthesize information found online as well as to represent their research and analysis clearly and coherently. Pairing students to work collaboratively, designing guided inquiry tasks that are engaging and relevant to their interests, and prompting their higher-order thinking, as suggested in the opening scenario featuring Ms. Jackson, and further illustrated through the examples woven throughout this piece, can tangibly improve students online reading, writing, and collaboration skills. Listening carefully to students' dialogue and offering teacher prompts for quality dialogue can improve higher-order thinking and provide just the right amount of support to students engaged in online inquiry.

Offering all students opportunities to engage in online reading and writing is an important equity issue. Engaging students in these activities and building in guidance from teachers and peers in the form of peer dialogue and teacher prompts encourages productive and quality collaborative talk. Scaffolding students' online inquiry skills in these ways will develop their digital literacies and may make them more college and career ready. Online reading and writing needs to have a prominent place in the curriculum, as do use of the technological devices that the majority of teachers recognize and often have available. It is imperative to provide students with opportunities, such as the structured inquiry learning experiences described here, so they can learn a range of strategies for reading and communicating in the digital age.

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