

Can middle schoolers learn to read the web like experts? Possibilities and limits of a strategy-based intervention

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ABSTRACT

This paper describes the strategies 8th graders used to evaluate the credibility of unfamiliar websites after a curricular intervention. Website topics were somewhat contested, and students could navigate the open web in order to assess the credibility of the sites. Findings reveal that students were more likely to leave the presented webpages and investigate the sources before making a credibility judgment after the curricular intervention. Furthermore, after the intervention students were more likely to prefer a more credible source of information over a less credible source when the two sources were presented. However, few students improved in their ability to assess a single deceptive website, despite applying several of the strategies taught in the intervention. We conclude that strategy- and skills-based information literacy instruction holds promise but must be paired with foundational knowledge about how the internet is structured and the kinds of online sources.

Keywords: *information literacy, digital literacy, media literacy, middle school, credibility.*



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INTRODUCTION

Research has established that people of all ages struggle to evaluate the information they encounter online (e.g., Barzilai & Zohar, 2012; List et al., 2016; McGrew, 2020; McGrew et al., 2018; Wineburg et al., 2016). Simultaneously, young people have become increasingly connected to the internet and reliant on online sources for information about current events. In 2018, the Pew Research Center found that nearly 95% of teenagers own a smart phone (Anderson & Jiang); the following year, Common Sense Media (2019) reported that a majority of adolescents get their news via social media and YouTube. As these statistics suggest, teaching students to evaluate online information is important to the future of our democracy.

Developing curriculum that supports students in this area has been the heart of our work over the past several years. In this paper, we discuss how sixteen eighth grade students evaluated a set of live websites after participating in a one-day curricular intervention. Specifically, we address the following research questions:

- After a one-day information literacy workshop, how successfully do eighth graders assess the credibility of websites?
- What strategies do students use to make their credibility determinations?
- How do these strategies compare with the strategies they used prior to the workshop?

LITERATURE REVIEW

Challenges in the online information ecosystem

Determining the credibility of online information is difficult for users of all ages. Perhaps because of this challenge, researchers have found that people rely on an array of factors to determine the credibility of the online information they encounter, including: source or site cues (e.g., domain name suffix, appearance); author cues (e.g. presence of an author's name, credentials); message cues (e.g., date, links to other sources); along with qualities of the individual user (e.g., age, prior knowledge, motivation) (Metzger & Flanagin, 2015). In some studies, these cues and qualities appear to be mobilized at random by individuals as they attempt to assess the credibility of information, with few people using a systematic approach (Kohnen et al., 2019; Macedo-Rouet, et al., 2019; Walraven et al., 2008;

Wineburg & McGrew, 2019). Social psychology research has established that this finding appears to be especially true when users are not motivated to investigate credibility deeply (Brante & Strømsø, 2018). Other studies have found that users judge information as trustworthy when it aligns with their existing beliefs (confirmation bias) or when friends have shared it (e.g., Kahne & Bowyer, 2017; Lynch, 2016; Velasquez, 2012), or when the information appears to have been trusted by others (e.g., number of likes or retweets; high position on a search results page) (e.g., Hargittai et al., 2010; Metzger et al., 2010; Waddell, 2017).

To further complicate matters, determining the credibility of information has grown more difficult over the past decade as the internet itself and our connectivity to it has changed. Philosopher Michael Lynch (2016) argued that our dependence on digital tools for information is now the “fastest and easiest way of knowing,” supplanting “other ways of knowing, ways that require more creative, holistic grasps of how information connects together” (pp. xv-xvii). The easier it is to access information, Lynch posited, the more likely we are to treat it as automatically credible, much as we instinctively trust information acquired through our senses.

Lynch referred to this way of knowing as “Google knowing,” but the challenges of the current web environment are about more than Google's dominance. Since the internet's invention, it has undergone several iterations, sometimes referred to as Web 1.0, 2.0, and 3.0 (Aghaei et al., 2012). Web 3.0, our current era, is also called the “smart Web” (Lynch, 2016) or the platform-based web. Web 3.0 is individualized, customized, and flat (i.e., search queries will be autocompleted and organized based on user characteristics, and ads will follow users from platform to platform and device to device) (Rudman & Bruwer, 2016). Web 3.0 is also ubiquitous, embedded in everything from wearable technologies to home appliances and marked by the monetization of all aspects of the experience, including the attention of users (Wu, 2016).

One of Web 3.0's defining characteristics is the platform-based nature of most user's experiences. Rather than taking action to arrive at a website, many users encounter content through social media, Google's homepage, or videos that automatically “play next.” This means that features once used to assess credibility may be hidden, lost, or simply unnoticed by users (note that the word “Google” is frequently used synonymously with “search online” potentially

minimizing the corporation's role in organizing results in most users' minds).

Simultaneously, sophisticated "cloaked websites" (Daniels, 2009), or those with hidden biases or motives (such as an anti-abortion group funding a website that appears to offer impartial health advice), incorporate many of the credibility cues identified by researchers in order to project a false aura of trustworthiness. As Marsh and Yang (2017) noted, "*typical cues for credibility have been hijacked, making source evaluation increasingly difficult*" (p. 401, emphasis in original). Furthermore, though most users experience the internet as existing without human involvement, the algorithms and architecture upon which it is built were created by humans and are thus encoded with all of humanity's biases (Noble, 2018). Finally, research has demonstrated that basic reading comprehension is more challenging in a digital environment (Proaps & Bliss, 2014; Singer & Alexander, 2017). In other work, we have argued that the complexities of the current web environment require equally complex instructional responses, ones that focus on developing students' expert information seeking *identities*, not just their technology skills (Kohnen & Mertens, 2019).

Interventions may help

Although we believe a robust identity-focused curriculum will be necessary for long-term change in student behaviors, previous research has demonstrated that interventions and direct instruction can help students improve their ability to reason about information credibility. Both Zhang and Duke (2011) and Macedo-Rouet et al. (2013) found that students in fourth and fifth grade became more critical in their stance toward information after short instructional interventions, while Argelag s and Pifarr (2012) concluded that seventh and eighth graders developed better searching and evaluation strategies after a set of lessons embedded in the curriculum. Similarly, several studies found that secondary students improved their ability to evaluate online information after short instructional interventions in the form of a unit of study or a handful of information literacy lessons integrated into the regular curriculum (e.g., Pérez et al., 2018; Walraven et al., 2013).

Students also appear to benefit from explicit instructions that direct them to look for certain pieces of information in order to assess credibility. Br ten, McCrudden et al. (2018) found that ninth graders who were given task instructions that prompted them to

consider author credibility did so when identifying evidence for use in a letter to the editor about an unfamiliar topic. Other studies have found that worksheets requiring students to look for particular characteristics about sources can serve as scaffolds (Kammerer et al., 2016; Mason et al., 2014).

However, as McGrew (2020) noted, such interventions are often based on credibility checklists or heuristics and warned that "by focusing students on surface features internal to a website, checklists are likely to lead students in the wrong direction." Moreover, these checklists were developed for earlier iterations of the web and have less utility in the current web environment (Kohnen, 2019; Marsh & Yang, 2017). In contrast, McGrew reported on an intervention in an eleventh-grade history classroom that was developed using her previous research with the Stanford History Education Group (McGrew et al., 2018; Wineburg & McGrew, 2019; Wineburg et al., 2016). Students were taught a series of skills-focused lessons based on the practices of professional fact checkers, centered on three questions fact checkers ask when encountering an unfamiliar source: Who is behind the information? What is the evidence? and What do other sources say? At the conclusion of the intervention, students demonstrated improved ability to: (1) determine more about sources behind websites, (2) question evidence offered on social media, and (3) locate credible sources of information about a contested topic via an open web search.

Despite these promising results, McGrew's study left open questions. Most importantly, the study did not capture students' actions on the open web, instead relying on students' written accounts of their process. Additional information about how students navigated these tasks would help teachers and researchers with future intervention development. Secondly, the study was embedded in an eleventh-grade class; how students in younger grades might fare was unexplored. This paper builds on McGrew's work by addressing both of these questions regarding middle-grade students' processes on the web.

METHOD

In this study, we sought to develop and assess a short intervention based on the work of Wineburg and McGrew (2019) for students in eighth grade. We believe middle school represents an opportune time for information literacy instruction from both a developmental and sociocultural perspective.

Developmentally, previous research has demonstrated that middle-school students are able to learn sourcing skills (Brante & Strømsø, 2018). Furthermore, by high school most students in the U.S. own a smartphone (Pew Research Center, 2018) and have opened at least one social-media account (Rideout & Robb, 2019). Thus, middle school may represent a window of time where students can learn important skills for navigating the web before they have an ingrained set of habits that may be difficult to break.

Our goal in this work was to determine whether eighth graders could improve their ability to assess the credibility of unfamiliar websites after learning basic information about how the internet is structured and how search engines work, along with specific skill instruction on how to determine the sources behind websites. Our earlier work had established that eighth graders in our intervention classroom struggled with these tasks (Kohnen et. al, 2019); we next hoped to learn what, if anything, students were able to apply from a short curricular intervention. In this article, we report on data collected in the spring of 2019. For comparison purposes, we also refer to results of a fall 2018 pre-assessment.

Participants and setting

Participants were all in eighth grade at a K-12 U.S. public school that had a one-to-one laptop program at the middle and secondary grade levels. The entire eighth grade class (n = 110) was invited to participate in the research; once parental consent and student assent were obtained, we worked with the classroom teacher to select twenty-five students who represented the diversity of the class in terms of gender, race, socioeconomic status, and previous performance in ELA classes. Data collection began in October with a pretest; during that time, scheduling issues and technological glitches limited us to 16 complete data sets. For comparison purposes, in this article we report on the posttest results of the same 16 individuals.

Teachers at the school had a great deal of curricular freedom, and the classroom teacher centered his ELA classes around essential questions and student inquiry. Students utilized their school-issued laptops to access readings and other texts (e.g., videos, songs, websites) that the teacher uploaded into the online classroom portal and to complete assignments. Despite operating in a technologically rich environment, the classroom teacher made few explicit modifications to

his ELA curriculum to incorporate information literacy skills, and students were rarely asked to assess information on the open web.

The research team had worked with the classroom teacher for several years on various projects related to ELA teaching and learning, and during the 2018-2019 academic year we focused on piloting a short curricular intervention related to information literacy. Our goal was to see if a one-day curricular invention in the form of an information literacy workshop made any impact on the information literacy skills of eighth graders, with the eventual aim of developing a more integrated information literacy curriculum that could be embedded during the full academic year.

The intervention

The one-day curricular intervention lasted approximately ninety minutes and was co-taught by Angela (author 1) and Gillian (author 2) in April of 2019. The workshop focused on: providing students with a basic understanding of how the internet and search engines like Google function; facilitating a discussion about the concept of credibility and how one might assess credibility around topics of personal interest; and teaching a few basic skills for assessing credibility, including reading a Wikipedia page, opening new tabs to search for more information (what Wineburg & McGrew called “lateral reading”), corroborating information across sources, and understanding the financial ties of a source. All students who were in attendance participated in the workshop.

Data collection

Data were collected in May, approximately 2-3 weeks after the intervention described above. Our data collection protocol was adapted from Wineburg and McGrew (2019). In this article we discuss results from the spring protocol (see Table 1); all participants had previously completed three similar tasks involving different websites in October of the same school year.

In the first task, which was designed as a warm up only and was not analyzed, students were reminded of the think-aloud procedure (Ericsson & Simon, 1993; Pressley & Afflerback, 1995) and asked to practice thinking aloud while looking up the formula to calculate the slope of a line. Students had an opportunity to practice using the computer’s external mouse and to get feedback on their verbalization.

Table 1. *Tasks and website*^a

| Task/Goal | Topic | Website/s presented | Participants could |
|---|--|--|---|
| Task A: Practice Think Aloud <i>This task was a warmup only.</i> | Looking up the formula for calculating the slope of a line | Google | Access information online Time Limit: 5 minutes |
| Task B: Evaluating sites individually and comparing two sites | Vaccination ^b | CDC: “What are the Reasons to Vaccinate My Baby?” ¹ VacTruth: “10 Reasons Not to Vaccinate” ² | Scroll, click on links, and leave the site to access information online Time Limit: 10 minutes |
| Task C: Evaluating one site and finding the funder of that site | The state of the environment | Environmental Policy Alliance: “The Environment is Improving” ³ | Scroll, click on links, and leave the sites to access information online Time Limit: 8 minutes |

^a Table adapted from Wineburg and McGrew (2019)

^b This topic was selected in summer 2018, prior to the measles outbreak of spring 2019. One of the websites we originally selected was no longer accessible in spring 2019 and was replaced with the VacTruth website. Data were collected during the measles outbreak, which did not impact the geographic region.

In the second task, students were shown two websites on the topic of vaccinations. The websites were presented one at a time and students could spend up to 5 minutes assessing the credibility of each. When the participant was ready (or after 5 minutes had passed), they were asked to assess the credibility of the site and to explain their reasoning. Once students had evaluated both websites, they were asked which site they thought was more credible and to rank their confidence in their assessment on a scale of 1 to 5.

In the third task, students were asked to determine the credibility of a webpage about the state of the environment. Once again, students were given 5 minutes and, at the conclusion of the time, were asked if they thought the website was a credible source of information on the state of the environment. Finally, they were given an additional 3 minutes to find the sponsor or funder of the website. For all tasks, the students worked with live websites and could leave the presented webpage at any time.

Website topic was a source of discussion in our research team. Because of the rapidly changing nature of the internet, selecting websites for use in a live assessment is a challenge; we also wanted to select appropriate topics for middle school students. Our goal was to select topics that would be familiar to students

because of their age (a booster vaccination is required in middle school) or due to previous curricular content, but that the students were not actively learning about in school at the time of the assessment.

Procedure

Data collection was administered by one of the authors during the student’s ELA class period in a small office connected to the classroom. Each participant spent less than 25 minutes completing the tasks. The protocol was administered on a MacBook Air with an external mouse using the Chrome web browser (students all had school-issued Chromebooks and were familiar with the browser). Prior to each session, we cleared the browser history.

Tasks were recorded using Quicktime, which captured the computer screen and the audio of the student and researcher. Because all participants had previously completed similar tasks, they were familiar with the process of verbalizing their thinking as they interacted with the websites and required little prompting. When students were silent for an extended length of time, researchers prompted with questions such as, “Can you tell me what you’re thinking?” or a question about a specific action the student had taken

¹ <https://www.cdc.gov/features/reasonstovaccinate/index.html>

² <https://vactruth.com/2014/12/12/10-reasons-not-to-vaccinate/>

³ <http://environmentalpolicyalliance.org/the-environment-is-improving/>

(e.g., “Can you explain why you opened a tab?”). The researcher completed a rubric and took brief field notes after each participant completed the tasks (see Appendix A).

Data analysis

Two researchers watched all task recordings and coded tasks according to a codebook developed during the pretest data analysis (see Kohnen et al, 2019, for a description of the codebook development). The codebook was designed to capture all the strategies students employed in their efforts to assess the credibility of the websites presented.

In order to allow us to identify differences in the way students approached the different kinds of sites, we subdivided the two coded tasks (B and C) into four tasks (B1, B2, C1, and C2). Task B1 was the site about vaccinations written by the Centers for Disease Control and Prevention; task B2 was the site about vaccinations written by the group Vactruth and included the question asking students to compare the two vaccination websites; task C1 was the website the Environmental Policy Alliance; and task C2 was when we asked students to look for the funder of the Environmental Policy Alliance (only completed by those who had not already identified the website’s sponsor as part of task C1).

The following thematic categories were represented in the 38 codes: (1) reading strategies (i.e., those that had curricular origins in reading instruction); (2) mnemonic/checklist strategies (e.g., the CRAP test – currency, relevance, accuracy, perspective; see Kohnen, 2019; Breakstone et al., 2018; Metzger, 2007); (3) expert strategies, or those identified by Wineburg and McGrew (2019) as ones used by professional fact

checkers; (4) novice strategies, or those identified by Wineburg and McGrew as ones used by nonexperts; and (5) site-specific factors, or features specific to the website that the students commented on or claimed to use that did not fall under other captured categories (see Appendix B for the codebook).

We did not attempt to code whether or not a student successfully employed a strategy or correctly understood the heuristic or factor employed. For example, if a student claimed a website had “good sources” because of embedded hyperlinks in the text, we coded “referenced credible sources,” even if the hyperlinks did not connect to sources of information or if the hyperlinks connected to suspect sources. We did so because we were most interested in understanding what frameworks students were attempting to use (in this example, the students recognized the importance of credible sources, even if identifying credible sources was a challenge), but this issue was a source of frequent conversation for the research team. We discuss implications of this choice later in this article.

FINDINGS

Based on task rubrics, students were moderately successful at the tasks (see Table 2). Seven of 16 students provided a specific, warranted evaluation of the credibility of the first vaccination website, and six students did so for the second vaccination website. Thirteen of the 16 students provided a warranted justification for why they would trust the Centers for Disease Control and Prevention’s website over the Vactruth site. However, only three of the 16 students provided a warranted evaluation of the website of the Environmental Policy Alliance.

Table 2. *Explanation of credibility judgments: posttest^a*

| | Incorrect evaluation of credibility | Accurate but vague or unwarranted explanation | Specific, accurate, warranted explanation |
|-------------------------------|--|--|--|
| CDC.gov | 1 | 8 | 7 |
| Vactruth.com | 4 | 6 | 6 |
| CDC <i>versus</i> Vactruth | 2 | 1 | 13 |
| Environmental Policy Alliance | 12 | 1 | 3 |

^an = 16

Overall, students appeared to have improved their ability to evaluate unfamiliar websites after the workshop intervention. In both the pre- and the posttest version of the tasks, we included a government website and an advocacy website as part of Task B and a front-group website for Task C. Though websites themselves

were unique in the features (e.g., graphs, pictures, testimonials, hyperlinks), we were encouraged by the increase in the total number of specific, accurate, and warranted explanations students gave for their credibility assessments (scored a “2” on the rubric) (see Table 3).

Table 3. *Explanation of credibility judgment across all tasks: pre- to post*

| | Incorrect evaluation of credibility | Accurate but vague or unwarranted explanation | Specific, accurate, warranted explanation |
|-----------------------|--|--|--|
| Pretest ^a | 30 | 26 | 8 |
| Posttest ^a | 19 | 16 | 29 |

^a 16 students offered explanations for 4 different questions, for a total of 64 explanations

To understand the increased number of accurate, warranted explanations, we compared the strategies students used pre- to posttest. The students employed a similar overall number of strategies (see Table 4). They also used similar kinds of strategies, relying mostly on reading strategies and their understanding of credibility heuristics.

At the thematic level, the largest differences were in the increased number of expert strategies used and the decreased number of site-specific factors referenced in the May posttest. Because the codes in the “site-specific

factors” category were developed based on the October pretest websites, the decrease in numbers is not surprising. For example, on the pretest, one of the webpages had a bulleted list of “testimonials,” which many students claimed to trust. On the posttest, there were no such testimonials. Therefore, we consider the increased number of expert strategies employed to be the most important difference between the pre- and posttest performance. We begin our analysis of pre- to posttest changes with expert strategies, followed by an analysis of other intriguing changes noted in the posttest coding.

Table 4. *Total strategies used by thematic group, pre to post*

| | Pretest | Posttest |
|-----------------------|----------------|-----------------|
| Reading strategies | 163 | 166 |
| Mnemonic/Checklist | 124 | 134 |
| Expert strategies | 55 | 94 |
| Novice strategies | 34 | 32 |
| Site-Specific factors | 55 | 31 |
| Total | 431 | 457 |

Changes in expert strategies used: Pre- to posttest

We argue the difference in total number of expert strategies used was mainly due to increases in a few specific strategies, all of which we taught during the one-day workshop (see Table 5). When confronted with an unfamiliar website, students were more likely to open a new tab and Google the name of the website during the posttest than they were in the pretest. They were also more likely to skim the search engine results, rather than clicking on the first one or two links.

However, we found no increases in students’ ability to select a credible source from the list of search engine results. This may be due in part to the websites used in the posttest. Students who Googled the “Centers for Disease Control and Prevention” generally looked at the short Google summary (which includes a such things as a map, the beginning of the Wikipedia entry, Google reviews, the phone number, etc.) and sometimes clicked the Wikipedia link. During the intervention, students were taught to read a Wikipedia page and to use Wikipedia for background information, but few students

articulated that they were attending to this information *because* they thought it was credible. On the other hand, some students who tried to Google the name of the website in Task C, the Environmental Policy Alliance, made typing errors or incorrectly selected autocomplete suggestions and ended up looking at a Google search results page for the Environmental Protection Agency.

Finally, we saw a slight decrease in the number of times students deliberately looked for the funder of a

website without prompting, even though part of the workshop was about determining the financial ties of a source. When prompted to look for the funder of the Environmental Policy Alliance, five of the 16 students found the funder and subsequently raised concerns about the source’s credibility, but only one student did so without being asked.

Table 5. *Expert strategies used, pre- to post*

| | Pretest | Posttest |
|---|---------|----------|
| Opening a new tab | 12 | 26 |
| Googling the website | 7 | 19 |
| Skimming search engine results | 10 | 15 |
| Going back and forth between sites | 6 | 11 |
| Selecting a credible source from search engine results | 7 | 7 |
| Employing background knowledge regarding a specific website | 5 | 6 |
| Corroborating information against another site | 4 | 5 |
| Employing background knowledge of how search engines work | 2 | 4 |
| Looking for a site’s funder (unprompted) | 2 | 1 |

Changes in novice strategies used: Pre- to posttest

Though students demonstrated increased ability to use expert strategies to assess credibility, they still used several novice strategies (see Table 6), sometimes in conjunction with expert strategies. For example, upon opening a new tab (an expert strategy), students did not always search the name of the website. Instead, a few students Googled questions like, “Is Vactruth credible?” or, occasionally, topics such as “vaccinations.” Although we consider these moves novice (for reasons we explain below), we were encouraged by any increase in the number of times students left the presented webpages because it suggests that students were beginning to realize that credibility is best determined by looking beyond the webpage itself. Students also clicked fewer internal links on the posttest than they did on the pretest, once again suggesting that they were aware that staying within the single website was not sufficient to assess credibility.

Yet questions in search engines do not lead to predictable results and still must be considered a novice strategy. On the pretest, students’ use of these queries appeared to for the purpose of corroborating information

rather than assessing the credibility of the source itself. The few students who continued to use questions as search terms on the posttest were no longer attempting to corroborate information; instead, they entered a question such as “Is [website/organization] credible?” Clearly, they recognized that they had to assess the credibility of the source, but this method of searching led to uneven results. For websites like “Vactruth,” the question “Is Vactruth credible?” led to fact-checking websites and articles that helped the student see the website presented a non-scientific point of view on vaccine safety. Yet typing “Is the CDC credible?” produced search results that questioned the CDC’s credibility (e.g., news stories of scandals at the organization or about controversial policies), leading this student to suggest that the CDC and Vactruth were both equally not reliable. The very act of questioning the credibility of a source in a search query produced search results that questioned the source’s credibility. Therefore, we believe typing a question questioning a source’s credibility into a search engine is not an advisable first step to determine credibility in the current internet landscape.

Table 6. *Novice strategies used, pre- to post*

| | Pretest | Posttest |
|---------------------|---------|----------|
| Click internal link | 23 | 17 |
| Google a topic | 8 | 11 |
| Google a question | 3 | 4 |

Other notable changes: Pre- to posttest

Overall, the students utilized more reading strategies and strategies rooted in their previous instruction about the internet (our mnemonic/checklist theme) than any other coded thematic categories. Due to space constraints, we will discuss only the most notable changes in this article (see Table 7).

A few of the pre- to posttest changes may be attributed to the fact that students had a better understanding of the tasks during the posttest. For example, they appeared more willing to verbalize their thinking on the posttest, summarizing the content they read much more frequently and making more general comments about the websites. A better understanding of the tasks and our goals as researchers may also explain the large drop in the number of personal opinions offered on the posttest.

Three changes in these categories suggest that students were attempting to apply what was taught in the workshop. Students were much less likely to click external links on the posttest, and they were less likely to engage in word-for-word reading of an external site. These two changes may indicate that students had a more focused process on the posttest and spent less time randomly clicking links and then carefully reading what they found. They were also more likely to comment on domain name on the posttest, particularly for the government website. In the workshop, we spent a small amount of time discussing domain names, specifically teaching that domain names like .com and .org are not good indicators of a website’s credibility, but that the website of a government agency that is tasked with research and/or oversight on a topic is usually a good source.

Table 7. *Other notable changes in strategies used, pre- to post*

| | | Pretest | Posttest |
|--------------------|---|---------|----------|
| Reading | Orally summarizing content | 8 | 21 |
| | Word for word reading of original site | 7 | 19 |
| | Word for word reading of external site | 28 | 12 |
| | Read title | 13 | 8 |
| | Comments on text features | 4 | 14 |
| Mnemonic/Checklist | Referenced domain | 28 | 6 |
| | Clicked external links | 8 | 14 |
| | Referenced site layout/appearance | 20 | 4 |
| | Referenced site’s use of credible sources | 15 | 22 |

The fact that fewer students read the titles of the articles presented in the posttest may also be an indicator that students were moving more quickly to assess credibility. Unfortunately, students may have benefited from reading the title of Environmental Policy Alliance’s article, “The Environment is Improving.” The students who did read this title were generally suspicious, commenting that this headline contradicted their prior knowledge. Yet, if the students were moving more efficiently to leave the original website, the

increase in number of times students read the original website word-for-word is surprising. Once again, this could be related to students’ understanding (or perception) of the tasks. More students may have read the original website out loud because they recognized that we wanted them to verbalize.

Finally, more students commented on a site’s use of “credible sources” during the posttest than did so on the pretest, but we see this code as particularly problematic. Students generally considered *any* source that was cited

a “credible source”; many also considered all hyperlinks as evidence of cited sources, regardless of what the hyperlink connected to. Furthermore, during the workshop we specifically warned students not to trust a source simply because it connected to or cited credible sources.

DISCUSSION

Similar to the McGrew (2020) study, our findings suggest that a short intervention could teach students to read laterally to investigate a source. McGrew found that 90% of participants attempted to read laterally after her intervention, yet not all were able to use the strategy effectively. Likewise, we found that students were able to apply the skill of lateral reading, but lateral reading alone without a more sophisticated understanding of the internet, types of websites (e.g., journalistic, advocacy, “cloaked,” fact checking), and the language of credibility (e.g., “front group”) was quite difficult. Students who left the displayed website often did not have the deeper understanding of the internet’s ecosystem needed to make sense of information they found about sources. For example, upon searching for the CDC in Google, one student was impressed by the organization’s four-star Google review and claimed to be skeptical of all online content with less than four stars. While we see her attempt to understand more about what was, for her, an unfamiliar source as important progress, we worry about her reliance on Google reviews as arbiters of truth.

Students had an even harder time using lateral reading in Task C when they only had a single source to evaluate. When investigating the funder of the Environmental Policy Alliance, several students determined that Richard Berman was the financial backer of this cloaked website, but they could not always connect what they learned with an assessment of the site’s credibility. For example, one student ended up on the sourcewatch.org entry for Berman & Co, an entry that describes the company as “operat[ing] a network of dozens of front groups, attack-dog web sites, and alleged think tanks.” Despite the red flags within this entry, the student was impressed by the accompanying photograph of Richard Berman on the TV show *60 Minutes*, along with the list of companies Berman has lobbied for (Cracker Barrell, Hooters, International House of Pancakes, etc.). Although the *60 Minutes* episode referred to Berman as “Dr. Evil,” the presence of the logo for the show appeared to give Berman an aura of credibility for this student, an aura that was strengthened

by the list of familiar restaurant names. The alarming language in the entry never appeared to register at all.

Furthermore, prior to leaving the Environmental Policy Alliance’s website, some students appeared fooled by its surface features, including the organization’s name and logo, along with the embedded video and a series of graphs credited to the Bureau of Economic Analysis, a fact that may have inhibited their lateral reading. Previous research has found that people rely on surface features to make credibility judgments when they are not motivated to engage in a deeper analysis (Brante & Strømsø, 2018), and lack of motivation may have been a factor in our study. However, we also found that students’ initial assessment of the website was difficult to overcome, regardless of their overall effort level on the tasks. For example, a highly engaged student who carefully evaluated the websites in Task B appeared fooled by the name “Environmental Policy Alliance,” claiming that “my dad actually used to work there.” We suspect her father may have worked for the Environmental Protection Agency, but, once convinced that the website was credible, the student never wavered. A second student mistakenly used the autocomplete suggestion to investigate the credibility of the Environmental Protection Agency; even when she noticed the two names and logos were not the same, she could not overcome her initial conviction that the site was credible.

In addition to other recommendations, McGrew (2020) suggested that students might benefit from learning to search a website’s name with the term “bias” or “funder.” However, as we noted earlier, we are not convinced using search terms like “bias” (or “credible”) would be useful because these terms appear to trigger search results questioning a site’s credibility automatically. Instead, we believe that students would benefit from instruction that helps them understand and recognize the various kinds of websites that exist online, a taxonomy not rooted in domain name suffixes or superficial features but instead in *purposes of information*.

We suspect that professional fact checkers can use questions like “who is behind this information?” because they have a more global understanding of the different kinds of sources available online. This study suggests that eighth graders need more foundational knowledge about the differences between news organizations, government agencies, advocacy groups, front groups, and more, in order to read laterally more successfully.

Recommendations and conclusions

We conclude this article with recommendations for curriculum development and for future research. First, we recommend that curriculum be developed that teaches students to recognize the types of sources encountered online, including those listed above (news organizations, government agencies, etc.). Without building this background knowledge, we believe students will always be fighting against misinformation without a sense of how to combat it. In our experience, it is easier to start with good examples of sources than to teach students to ferret out all the bad. For example, the Central Intelligence Agency's World Factbook is a good source for information about different countries, the Centers for Disease Control and Prevention includes credible health information, and various local, national, and international newspapers are good sources for current events. When students encounter an unfamiliar website, we recommend teaching a triage process. Determining a website's purpose is the first step – and will help students decide if the source is worth reading more carefully. Students should be taught to ignore superficial features and instead prioritize leaving the website to determine the source's purpose. Sometimes this is a straightforward process; in our experience, middle-school students have a lack of knowledge about almost *all* sources beyond major U.S. newspapers and broadcast networks, and determining the purpose and thus the ideology of a source like the British Broadcasting Corporation is a fairly quick endeavor. Other times, though, students will have to think more carefully about what they are learning about a source in order to make sense of its purpose. We have found this to be especially true in the case of non-profit organizations, some of which have highly credible information (e.g., The American Cancer Society) albeit from a particular perspective, while others have information that may deliberately mislead (some conspiracy theory or thinly veiled white supremacist groups are non-profit). We also caution that a balance of efficiency and care is needed when approaching websites. In this study, many students left the presented webpages quickly. In their haste, some missed content-related clues that may have helped them be more skeptical of the website's purpose (including headlines of articles).

Finally, we acknowledge that this research has several limitations, including a short intervention, an assessment based on researcher-selected websites and topics, and a codebook that did not capture variations in

how students applied different strategies. Accordingly, we make the following recommendations for future research. While our work confirms that small changes in the curriculum can increase information literacy, we recommend research into more robust curricular interventions (including those that are cross-curricular or even entire courses framed around information literacy) that afford student choice over content and forefront dispositions and identities rather than only skills and knowledge.

REFERENCES

- Aghaei, S., Nematbakhsh, M. A., & Farsani, H. K. (2012). Evolution of the World Wide Web: From Web 1.0 to Web 4.0. *International Journal of Web & Semantic Technology*, 3(1), 1-10. <https://doi.org/10.5121/ijwest.2012.3101>
- Anderson, M., & Jiang, J. (2018). Teens, social media & technology 2018. Pew Research Center. <http://www.pewinternet.org/2018/05/31/teens-social-media-technology-2018/>
- Argelag s, E., & Pifarr , M. (2012). Improving information problem solving skills in secondary education through embedded instruction. *Computers in Human Behavior*, 28, 515-526. <https://doi.org/10.1016/j.chb.2011.10.024>
- Barzilai, S., & Zohar, A. (2012). Epistemic thinking in action: Evaluating and integrating online sources. *Cognition and Instruction*, 30, 39-85. <https://doi.org/10.1080/07370008.2011.636495>
- Brante, E. W., & Strømsø, H. I. (2018). Sourcing in text comprehension: A review of interventions targeting sourcing skills. *Educational Psychology Review*, 30, 773-799.
- Bråten, I., McCrudden, M. T., Lund, E. S., Brante, E. W., & Strømsø, H. I. (2018). Task-oriented learning with multiple documents: Effects of topic familiarity, author expertise, and content relevance on document selection, processing, and use. *Reading Research Quarterly*, 53(3), 356-365. <https://doi.org/10.1002/rrq.197>
- Breakstone, J., McGrew, S., Smith, M., Ortega, T., & Wineburg, S. (2018). Why we need a new approach to teaching digital literacy. *Phi Delta Kapan*, 99(6), 27-32. <https://doi.org/10.1177/0031721718762419>
- Common Sense Media. (2019). Teen news engagement. Author and SurveyMonkey. https://www.commonsensemedia.org/sites/default/files/uploads/pdfs/2019_cs-sm_summarytoplines_release.pdf

- Daniels, J. (2009). Cloaked websites: Propaganda, cyber-racism and epistemology in the digital era. *New Media & Society, 11*, 659-683. <https://doi.org/10.1177/1461444809105345>
- Ericsson, K. A., & Simon, H. A. (1993). *Protocol analysis: Verbal reports as data* (Rev. ed.). MIT Press.
- Hargittai, E., Fullerton, L., Menchen-Trevino, E., Thomas, K. Y. (2010). Trust online: Young adults' evaluation of web content. *International Journal of Communication, 4*, 468-494. <https://ijoc.org/index.php/ijoc/article/view/636>
- Kahne, J., & Bowyer, B. (2017). Educating for democracy in a partisan age: Confronting the challenges of motivated reasoning and misinformation. *American Educational Research Journal, 54*(1), 3-34. <https://doi.org/10.3102/0002831216679817>
- Kammerer, Y., Meier, N., & Stahl, E. (2016). Fostering secondary-school students' intertext model formation when reading a set of websites: the effectiveness of source prompts. *Computers & Education, 102*, 52-64. <https://doi.org/10.1016/j.compedu.2016.07.001>
- Kohnen, A. M. (2019). Teaching online research as a critical literacy skill. *English Journal, 108*(5), 25-30. <https://library.ncte.org/journals/ej/issues/v108-5>
- Kohnen, A. M., & Mertens, G. E. (2019). "I'm always kind of double-checking": Exploring the information-seeking identities of expert generalists. *Reading Research Quarterly, 54*(3), 279-298. <https://doi.org/10.1002/rrq.245>
- Kohnen, A. M., Mertens, G. E., Dawson, K., Fu, D., & Hampton, J. (2019). A study of middle school students' online credibility assessments: Challenges and possibilities [Manuscript submitted for publication]. School of Teaching and Learning, University of Florida.
- List, A., Grossnickle, E. M., & Alexander, P. A. (2016). Undergraduate students' justifications for source selection in a digital academic context. *Journal of Educational Computing Research, 54*, 22-61. <https://doi.org/10.1177/0735633115606659>
- Lynch, M. P. (2016). *The Internet of us*. Liveright Publishing Corporation.
- Macedo-Rouet, M., Braasch, J. L., Britt, M. A., & Rouet, J.-F. (2013). Teaching fourth and fifth graders to evaluate information sources during text comprehension. *Cognition and Instruction, 31*, 204-226. <https://doi.org/10.1080/07370008.2013.769995>
- Macedo-Rouet, M., Potocki, A., Scharrer, L., Ros, C., Stadtler, M., Salmerón, L., & Rouet, J.-F. (2019). How good is this page? Benefits and limits of prompting on adolescents' evaluation of web information. *Reading Research Quarterly, 54*(3), 299-321. <https://doi.org/10.1002/rrq.241>
- Marsh, E. J., & Yang, B. W. (2017). A call to think broadly about information literacy. *Journal of Applied Research in Memory and Cognition, 6*(4), 401-404. <https://doi.org/10.1016/j.jarmac.2017.09.012>
- Mason, L., Junyent, A. A., & Tornatora, M. C. (2014). Epistemic evaluation and comprehension of web-source information on controversial science-related topics: effects of a short-term instructional intervention. *Computers & Education, 76*, 143-157. <https://doi.org/10.1016/j.compedu.2014.03.016>
- McGrew, S. (2020). Learning to evaluate: An intervention in civic online reasoning. *Computers & Education, 145*. <https://doi.org/10.1016/j.compedu.2019.103711>
- McGrew, S., Breakstone, J., Ortega, T., Smith, M., & Wineburg, S. (2018). Can students evaluate online sources? Learning from assessments of civic online reasoning. *Theory and Research in Social Education, 46*, 165-193. <https://doi.org/10.1080/00933104.2017.1416320>
- Metzger, M. J. (2007). Making sense of credibility on the Web: Models for evaluating online information and recommendations for future research. *Journal of the Association for Information Science and Technology, 58*(13), 2078-2091. <https://doi.org/10.1002/asi.20672>
- Metzger, M. J., & Flanagin, A. (2015). Psychological approaches to credibility assessment online. In S. S. Sundar (Ed.), *The Handbook of the Psychology of Communication Technology* (pp. 445-465). Hoboken, NJ: John Wiley & Sons.
- Metzger, M. J., Flanagin, A. J., & Medders, R. B. (2010). Social and heuristic approaches to credibility evaluation online. *Journal of Communication, 60*, 413-439. <https://doi.org/10.1111/j.1460-2466.2010.01488.x>
- Noble, S. (2018). *Algorithms of oppression: How search engines reinforce racism*. NYU Press.
- Pérez, A., Potocki, A., Stadtler, M., Macedo-Rouet, M., Paul, J., Salmerón, L., Rouet, J.-F. (2018). Fostering teenagers' assessment of information reliability: Effects of a classroom intervention focused on critical source dimensions. *Learning and*

- Instruction*, 58, 53-64.
<https://doi.org/10.1016/j.learninstruc.2018.04.006>.
- Pressley, M., & Afflerbach, P. (1995). *Verbal protocols of reading: The nature of constructively responsive reading*. Erlbaum.
- Proaps, A. B., & Bliss, J. P. (2014). The effects of text presentation format on reading comprehension and video game performance. *Computers in Human Behavior*, 36, 41-47.
<https://doi.org/10.1016/j.chb.2014.03.039>
- Rideout, V., & Robb, M. B. (2019). *The Common Sense census: Media use by tweens and teens*. Common Sense Media.
<https://www.commonsensemedia.org/research>
- Rudman, R. & Bruwer, R. (2016). Defining Web 3.0: Opportunities and challenges. *The Electronic Library*, 34(1), 132-254. <https://doi.org/10.1108/EL-08-2014-0140>
- Singer, L. M., & Alexander, P. A. (2017). Reading on paper and digitally: What the past decades of empirical research reveal. *Review of Educational Research*, 87 (6), 1007-1041.
<https://doi.org/10.3102/0034654317722961>
- Velasquez, A. (2012). Social media and online political discussion: The effect of cue and informational cascades on participation in online political communities. *New Media & Literacy*, 14(8), 1286-1303. <https://doi.org/10.1177/1461444812445877>
- Waddell, T. F. (2017). What does the crowd think? How online comments and popularity metrics affect news credibility and issue importance. *New Media and Society*, 20(8), 3068-3083.
<https://doi.org/10.1177/1461444817742905>
- Walraven, A., Brand-Gruwel, S., & Boshuizen, H. P. (2013). Fostering students' evaluation behaviour while searching the internet. *Instructional Science*, 41, 125-146. <https://doi.org/10.1007/s11251-012-9221-x>
- Walraven, A., Brand-Gruwel, S., & Boshuizen, H. P. (2008). Information-problem solving: A review of problems students encounter and instructional solutions. *Computers in Human Behavior*, 24, 623-648. <https://doi.org/10.1016/j.chb.2007.01.030>
- Wineburg, S., & McGrew, S. (2019). Lateral reading and the nature of expertise: Reading less and learning more when evaluating digital information. *Teachers College Record*, 121(11).
- Wineburg, S., McGrew, S., Breakstone, J., & Ortega, T. (2016). *Evaluating Information: The Cornerstone of Civic online Reasoning*. Stanford History Education Group. <https://purl.stanford.edu/fv751yt5934>.
- Wu, T. (2016). *The attention merchants: The epic scramble to get inside our heads*. Alfred A. Knopf.
- Zhang, S., & Duke, N. (2011). The impact of instruction in the WWWDOT framework on students' disposition and ability to evaluate web sites as sources of information. *The Elementary School Journal*, 112, 132-154.
<https://doi.org/10.1086/521238>.

APPENDIX A

Task Rubrics⁴

Task B: Vaccines

| Score | Description | Researcher Notes |
|-------|---|------------------|
| 2 | Specific, accurate, warranted description of CDC.gov | |
| 1 | Accurate but vague or unwarranted evaluation of CDC.gov | |
| 0 | Incorrect evaluation of CDC.gov | |

| Score | Description | Researcher Notes |
|-------|--|------------------|
| 2 | Specific, accurate, warranted description of Vactruth.com | |
| 1 | Accurate but vague or unwarranted evaluation of Vactruth.com | |
| 0 | Incorrect evaluation of Vactruth.com | |

| Score | Description | Researcher Notes |
|-------|--|------------------|
| 2 | Specific, accurate, warranted description of which site was more credible | |
| 1 | Accurate but vague or unwarranted evaluation of which site was more credible; indecisive | |
| 0 | Incorrect evaluation of which site was credible | |

Task C: The Environment is Improving

| Score | Description | Researcher Notes |
|-------|---|------------------|
| 2 | Specific, accurate, warranted description of environmentalpolicyalliance.org | |
| 1 | Accurate but vague or unwarranted evaluation of environmentalpolicyalliance.org | |
| 0 | Incorrect evaluation of environmentalpolicyalliance.org | |

⁴ Rubrics based on those developed by the Stanford History Education Group and released in the paper: Wineburg, S., & McGrew, S. (2017). Lateral reading: Reading less and learning more when evaluating digital information. Palo Alto, CA: Stanford History Education Group.

APPENDIX B

Codebook

| Thematic group | Code | Definition/Example |
|--------------------|---|--|
| Mnemonic/checklist | Referenced domain | "It is a .gov site and government sites are usually very professional and good sites to use." |
| Mnemonic/checklist | Referenced article publishing date | "It's copyrighted 2019 so it has been updated." |
| Mnemonic/checklist | Referenced having author listed | "Normally I would look at the name of whoever wrote it or the name of the company it is presented by." |
| Mnemonic/checklist | Referenced site including contact information | "They have their address and number but other than that they don't have any ways to contact them." |
| Mnemonic/checklist | Referenced author credibility | "She is yoga and fitness; not a doctor." |
| Mnemonic/checklist | Referenced website/author's purpose | "I would just say it's more of an opinion website, not, like, an institute that has stated real facts." |
| Mnemonic/checklist | Clicking external links | Clicks a link that takes them off the original website and onto an external site |
| Mnemonic/checklist | Referenced site layout/appearance | "it's just a bunch of clickbait along the side" |
| Mnemonic/checklist | Referenced site's use of credible sources | "Well, there's a lot of sources down here now" |
| Mnemonic/checklist | Expresses doubt about content encountered | "I didn't read much of evidence and stuff like that so I am not completely sure." |
| Reading | Read title | Reads the article's title |
| Reading | Orally summarizing content while reading | Orally summarizing content read |
| Reading | Referenced photos/graphics | "So, it is already starting with a video so I would probably watch it" |
| Reading | Skimming original site | Scrolls quickly without reading every word; can summarize content when asked; cursor often moves |
| Reading | Skimming external site | Scrolls quickly through another webpage without reading every word; can summarize content when asked; cursor often moves |
| Reading | Comments on text features | "I'd probably start by reading the subtitles and the bold words." |
| Reading | Personal opinion | "Based on my opinion, no, because I think you should vaccinate." |
| Reading | Background knowledge on topic | "Because I want to be an epidemiologist, so it really interests me" |
| Reading | Background knowledge (general) | "I'd probably click 'healthy pets, healthy people' because I do have a lot of pets." |
| Reading | Word-for-word reading original site | Orally reads the webpage word-for-word |

| Thematic group | Code | Definition/Example |
|-----------------------|---|---|
| Reading | Word for word reading another site | Orally reads a new webpage word-for-word |
| Expert practices | Goes back and forth between sites | Moves between two tabs |
| Expert practices | Opens a new tab | Opens a tab in addition to the presented tab |
| Expert practices | Google the website | Types the name of the website into Google |
| Expert practices | Corroborating information against another site/source | Compares information on two different sites, looking for agreement |
| Expert practices | Skimming search engine results | “I am looking for a source I know. Maybe this one [SourceWatch].” |
| Expert practices | Selecting credible source from search results | “I would use a fact checking website.” |
| Expert practices | Looked for funding unprompted | Searches for the funder of a website without being prompted to do so |
| Expert practices | Background knowledge (searching) | “I would see what there is and maybe sometimes you can find reviews, like there’s Google reviews here.” |
| Expert practices | Referenced other exposure to site | “My Mom is a doctor so she talks about the CDC” |
| Novice practices | Clicking internal links | Clicks a link to another webpage within the same website |
| Novice practices | Google a topic | Types “vaccine safety” into a search engine |
| Novice practices | Google a question | Types “who funds the environmental policy alliance?” into a search engine |
| Site-Specific Factors | Referenced presence of social media | “I see they supply their Facebook, Twitter... so that is already a good sign” |
| Site-Specific Factors | Referenced “official sounding” name | “This Center for Organizational Research and Education sounds pretty impressive” |
| Site-Specific Factors | Referenced site as non-profit | Often when reading an “about us” page |
| Site-Specific Factors | Referenced presence of facts/statistics | “I feel like it has a lot of facts. It has these charts down here.” |
| Site-Specific Factors | Referenced testimonials (also user comments) | “It’s cool that they have comments so you can see what other people are feeling about the website.” |