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# *Rapid shifts in educators' perceptions of data literacy priorities*

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## ABSTRACT

To meet the challenges of a data-driven society, high school students need new arrays of literacy skills. In the United States, school librarians, who work across disciplines, are well-positioned to help students improve their data practice, but they first need new domain knowledge. This article presents findings from an evaluating survey and session evaluation data from a virtual data literacy conference, which were part of a federally-funded project to develop data literacy skills among high school librarians and educators. Findings indicated a noticeable shift in participant perceptions of the need and urgency for data literacy instruction across content areas and grade levels concurrent with implementation of content-area data literacy standards. While the conference was geared toward high school educators and librarians, participants represented a broad audience of K-12 educators and K-20 librarians. The findings provide a valuable snapshot of shifting educational standards and priorities, along with needed pedagogical support and resources.

**Keywords:** *K-12 education, data literacy, K-12 educators, school librarians, information literacy*.

## INTRODUCTION

Social media's shifting privacy practices, algorithmically-determined work schedules, statistics encountered during class projects, and sophisticated voter targeting practices have intensified the urgency for data-savvy students. As data is deployed to answer complex questions, youth need critical thinking skills to understand algorithms, analysis methods, and the resulting statistics and visualizations. These skills include data visualization, statistical comprehension, personal data management, as well as the ability to make ethical judgments. School librarians, working across disciplines, are well-positioned to help students improve these practices, but they but need new domain knowledge before they can help their students meet these challenges.

This article presents findings from evaluating a virtual data literacy conference, which was part of a federally-funded project to develop data literacy as a subset of information literacy among high school librarians and educators. Information literacy is a term used to describe the process of researching and writing using a variety of resources (ACRL, 2000). Data for the current study were collected through a registration survey as well as participant evaluations of individual sessions' quality and relevance. Findings indicate a noticeable shift in participant perceptions of the need and urgency for data literacy instruction across content areas and grade levels, concurrent with emerging data literacy standards in the content areas. While the conference was geared toward high school educators and librarians, participants represented a broad audience of K-12 educators and K-20 librarians. Therefore, the findings provide a valuable snapshot of shifting educational standards and priorities, along with pedagogical support and resource.

## LITERATURE REVIEW

In the 21st century, it is more difficult than ever to silo different types of literacies. Media literacy, news literacy, and information literacy have overlapping definitions, and the synergies far outweigh the distinctions.

While each of these definitions theoretically includes data, the reality is that literacy interventions often concentrate on the dominant media – usually text. Hence, there is value in drawing out data literacy for a separate consideration.

### Defining data literacy

Data literacy definitions vary depending on industry, and can be applied in scholastic, workplace, and personal settings. Data literacy incorporates numeracy, quantitative literacy, and mathematical and statistical calculations, as well as problem-solving, communication, and decision-making. Mandinach and Gummer (2013, p. 30) define data literacy as

> the ability to understand and use data effectively to inform decisions […] how to identify, collect, organize, analyze, summarize, and prioritize data […] how to develop hypotheses, identify problems, interpret the data, and determine, plan, implement, and monitor courses of action.

As such, data literacy overlaps significantly with definitions of media literacy (NAMLE, 2019), information literacy (ACRL, 2000), news literacy (Hobbs, 2010), and statistical literacy (Schield, 2004). Data literacy may also include personal data management (Acker & Bowler, 2017; Fontichiaro & Oehrli, 2016) and guidance in ethical use (Fontichiaro & Oehrli, 2016). Several scholars have positioned data literacy as a subset of information literacy (Fontichiaro & Oehrli, 2016; Johnston & Jacobs, 2017; Peter & Kellam, 2013; Prado & Marzal, 2013). Schield was the first to explore the interconnectivity between information, statistical, and data literacy, defining information literacy as the ability to "think critically about concepts, claims and arguments: to read, interpret and evaluate information;" statistical literacy as "the use of statistics as evidence in arguments;" and data literacy as the ability to "access, assess, manipulate, summarize, and present data" (Schield, 2004, p. 8). While his 2004 definitions may be overly rigid for today's more fluid environment, he was the first to argue explicitly that data literacy should be embedded in information literacy instruction. Fontichiaro and Oehrli (2016) reinforced this, identifying six key themes as priorities for high school librarians: data and statistical comprehension, including terms of art; construction and critique of data-infused arguments; creation and interpretation of data visualizations; the promises and perils of Big Data; personal data management and the recognition of one's invisible data trail; and ethical behavior in using, collecting, and representing data.

For the purposes of this research, we did not include the following related subfields: research data management (data curation, storage, and repositories) (e.g., Koltay, 2017); data information literacy, library-based supports for data throughout the research life

cycle (e.g., Carlson & Johnston, 2015); and data science (Big Data, machine learning, and computational analysis) (DataScience@Berkeley, 2020). This project focused on Fontichiaro and Oehrli's six categories of data literacy identified above and broadly defined data literacy as being able to "read and write with data," focusing more on comprehension and communication than on algorithmic or mathematical manipulation (University of Michigan, 2020).

**The need for more skills in the 21st century**

In their personal and scholastic spheres, high school (HS) students are constantly encountering, evaluating, acting on, and impacted by data. After the 2001 No Child Left Behind Act, with its relentless focus on basic mathematical and reading literacy skills for standardized test scores, the pendulum swung back in favor of learning standards that promoted depth, conceptual understanding, and critical thinking. Organizations like the Partnership for 21st Century Learning (Trilling & Fadel, 2012) and the contemporaneous and ongoing Whole Child Initiative at ASCD (2020) encouraged, among other goals, engaged learning experiences, rigorous critical thinking activities, and a focus on college and career readiness. These were followed in 2010 by the Common Core State Standards (CCSSI, 2010), which encouraged research and literacy behaviors, including data, across the content areas. The Next Generation Science Standards followed and included new provisions for data visualization, analysis, and tabulation in each academic year (NGSS Lead States, 2013). The College, Career, and Civic Life (C3) Framework for Social Studies State Standards (National Council for the Social Studies, 2017) included a table showing data types used by various social scientists. While not adopted universally, these standards collectively articulated a multidimensional, multidisciplinary need for data literacy.

Even within traditional data-heavy subject areas, there was a shift from computational practices into a larger discussion of data in society. Mendez-Carbajo, Jefferson, and Stierholz (2019) wrote about infusing social justice themes into economic data explorations. MacKenzie emphasized perils of students memorizing lab steps but not being capable of interpreting social media or reports (2020). Bowen and Bartley wrote

> "Data literacy is important for your students even if they aren't going to be scientists because data are used to argue and persuade people to, among other things, vote… [or] support specific types of spending within organizations […] or lease a car" (2014, p. ix).

Frankenstein (2013) positioned mathematical understanding beyond number sense to statistics as a lens for understanding politics.

Beyond school, the nature of data is changing as cheap storage, the Internet of Things, and online tracking tools make it possible to near-instantly compile, analyze, and act on large volumes of data. While much of the early research in these areas was optimistic, the 2016 surprise election result in the United States, and the later revelation of the degree to which voters may have been manipulated based on their social media data, fueled a rapid surge in discussion of "fake news" and the need for students to be able to discern and critically understand information in various formats (e.g., Farmer, 2019; Stanford History Education Group, 2016). Educators and the broader society quickly recognized that students needed more savvy about how data was guiding, tracking, and sometimes weaponizing their daily moves.

While much has been written about students' conscious online behaviors (e.g., boyd, 2014), less is known about students' knowledge of and reactions to invisible online tracking and personal data management tools (Acker & Bowler, 2018). In fact, Acker & Bowler's (2017) qualitative interviews uncovered that many teens' initial conceptualization of online data was "data usage," the amount of bandwidth covered by their mobile device's monthly plan. Similarly, the introduction of algorithmic news feeds and the open, viral marketplace of social media has created a more chaotic information and media environment for everyone, particularly teens whose prior knowledge may not be fully developed or internalized (Acker & Bowler, 2017; 2018). Teens' lives today are increasingly guided by data: examples include an incarcerated relative's sentence based on algorithmic predictions of future recidivism (Gorner & Sweeney, 2020; Wilson, 2014); applicants shown different job ads depending on gender (Miller, 2015); manipulative visualizations in broadcast news (Shere, 2012); and microtargeting global voters as illustrated by the Cambridge Analytica scheme (Cadwalldr, 2020). These phenomena point to the need for an updated digital citizenship curriculum, one that focuses less on constructing online identity and more on personal data-savvy moves (Acker & Bowler, 2017). As Johnston and Jacobs (2017) write

> "[i]n a time of 'fake news' it is imperative that we teach students to interpret, understand, and comprehend data… so that they are

be better analysts when conducting research for school related projects, but also for their own personal decision making" (p. 46).

### Why the school librarian?

Given the volume of cross-curricular, multi-grade standards, schools need staff members who see the broad landscape of data literacy needs, concerns, and instruction across content areas (Johnston & Jacobs, 2017). Fontichiaro and Oehrli (2016) wrote: "Librarians are unique cross-disciplinary pollinators who can fill the gaps between subject areas" (p. 22). In most parts of the United States, school librarians are credentialed in one or more content areas with additional coursework in information literacy and school librarianship; management of and access to digital resources, collaborative curricular planning; and instruction to students and staff (Johnston, 2018). A school librarian is positioned as the building's research expert who works across all content areas on broader themes in digital literacy, information literacy, and digital citizenship, designing opportunities for students to analyze, interpret, build new knowledge, and communicate new understandings. Most HS librarians have flexible teaching schedules in order to support just-in-time classroom and individual research and learning. When not teaching, they are encouraged to lead professional learning and keep abreast of educational trends for dissemination to colleagues (Abilock et al., 2012).

This is important given the interdisciplinary nature of data. Data should not be constrained to any single academic domain (Vahey et al., 2012), and existing curriculum is already overstuffed (Finzer, 2013; Fontichiaro as cited in Smith, 2017). Skills need systematic, incremental acquisition over time (Finzer 2013; Prado & Marzal, 2013). Therefore, a cross-disciplinary approach that embeds data education within the context of existing disciplines is both preferable and practical. Given the complexities of mapping data literacy instruction across, say, an average-sized high school of 2000 students, a "point person" with cross-disciplinary skills and knowledge, such as the school librarian, is essential.

### Lack of professional preparation for data literacy

While school librarians are ideally positioned to be building-level coaches of data literacy, lack of knowledge hinders implementation. Research finds that some U.S. school librarians and teachers described themselves as uncomfortable or unprepared to teach data literacy skills (Fontichiaro & Oehrli, 2016). Despite the push for student assessment data to drive instruction, many building staff are ill-prepared to interpret the statistical meaning of said data (Moore et al., 2019; Schultz-Jones et al., 2019). While formal data is not available, it is common knowledge that most school librarians have humanities or history backgrounds where finding, manipulating, or comprehending data is emphasized. Additionally, research methods courses, which would ideally cement a preservice librarians' skills in finding, analyzing, and communicating data in the context of information literacy, are optional in many accredited library education programs.

## METHODOLOGY

In order to address the gap between the potential of school librarians as data literacy leaders and their knowledge gaps, this project brought together three data experts on data information literacy, data visualization, statistics, and data repositories with eight experts in curriculum and pedagogy in school librarianship. Through a series of physical and virtual meetings, readings and reflections, and discussions on how their new data knowledge interfaced with their everyday practices, the team created professional development (PD) in the form of virtual conferences; two handbooks on data literacy as integrated into information literacy for practitioners; and packaged PD activities that could be deployed locally for additional professional growth. The virtual conferences were held in the summers of 2016, 2017, and 2018. Participants attended their choice of 60-minute sessions throughout each year's two-day conference on various topics related to data literacy. Year 1 (2016) focused on the first three of Fontichiaro and Oehrli's identified focus areas: data and statistical comprehension, data in and for arguments, and data visualization. Year 2 (2017) addressed the other three focus areas: personal data management and data privacy; Big Data (and citizen science as a prosocial example of the power of pooled data); and ethical use of data. This last theme is notable given that ethical use of information is a cornerstone of librarianship (American Library Association, 2008). Year 3 (2018) was a late addition to the project. Many of its sessions focused on practical tools for implementation rather than umbrella concepts. For example, representatives of FRED, the economic data portal curated by the Federal Reserve Bank of St. Louis, demonstrated how the portal aligned with information literacy and research needs; the

Association of Religion Data Archives used its mapping tool to pull and synthesize Census tract-level data; senior project staff modeled how the use of the project's case studies publication could be used to jumpstart critical conversations; and a high school journalist walked through his efforts to select, analyze, and visualize data.

**Project data literacy scope**

The overarching purpose of this project was to help school librarians and educators better understand real-world data concerns and have the confidence and knowledge to share those skills with their patrons. Fontichiaro & Oehrli's six themes (2016) described above were set as project priorities. Data literacy for the team was broadly defined as "reading and writing with data," framing it less as a quantitative skillset and conceptualizing it as a variant of reading comprehension and written communication.

The purpose of this evaluation research was twofold: first, to address the project goal relating to the perceptions of the participants' current awareness of data literacy and its importance for students., and secondly, to examine the goal of a shift in practitioner awareness of, proclivity toward, and commitment to data literacy instruction.

To conduct the evaluation of this three-year project, data was collected through an online conference registration survey and post-session feedback forms from each individual session. Evaluation research is the systematic assessment of effort and resources spent in order to achieve a goal, in this case the goals of the project as stated above (Rossi et al., 2019).

**Participants**

Participants were recruited through postings on state and national library related listservs, social media, and emails to education and librarian organizations. In-state continuing education (CE) credit was made available to participants via the Michigan Department of Education portal. Grant funds were used to cover those administrative costs; therefore, CE credits were offered for free. Consequently, one of the limitations of this research is that this access to free credits may have influenced motivation to attend. Additionally, the virtual conference was held in the summer months outside the American academic year, when more educators would be inclined to attend.

Over three years, there were 1,730 participants: 495 in Year 1 (2016), 622 in Year 2 (2017), and 613 in Year 3 (2018). Participants spanned nearly 80 careers, including public and academic librarians and K-12 educators/librarians. Ages ranged from 20 to 74 and years of teaching experience ranged from none to 20 plus years of experience. Approximately one-third of registrants identified as being within the same state as the conference, but two-thirds were drawn from across the United States and beyond.

**Data collection**

Participants were asked to fill out a registration survey online as a requirement for attending the virtual conference; therefore, the response rate on the survey was 100%. In years two and three of the project, participants who had attended a previous year were asked additional questions about their experiences with implementing what they had learned. The survey was conducted using the Qualtrics program. Additionally, data was collected through individual post- session online feedback forms through Google Forms.

*Registration Survey.* The survey was developed over a twelve-month period by a team of three researchers. Since this study was a federally funded grant project, the survey was designed with the purpose of evaluating the project to see if it addressed the specific goals stated in the proposal. The survey was pilot tested with a group of eight with extensive experience in school librarianship. Yet, this was a newly developed survey and therefore a limitation of this research. The first section of the survey consisted of demographic questions covering areas such as name, geographic location, job/position, age, and teaching experience in years. In the next section participants were asked three open-ended questions to ascertain their perceptions of data literacy and its importance to students: your definition of data literacy, why is data literacy important to students, and why is data literacy important in your content area. The open-ended questions allowed respondents to provide personal answers in their own words, which yields useful information when researchers need to explore issues that do not have a finite or predetermined set of responses (Babbie, 2015; Dillman et al., 2009), as is the case in this research. In the third section, participants were asked two Likert scale questions to determine self-perceptions of their knowledge and confidence in working with quantitative data in relation to co-workers. In Years 2 and 3 of the project, additional questions were added to the survey

for those participants who had attended the virtual conference in one or both of the previous years about knowledge gained and implementation of what they learned. As with any research in which respondents self report, the responses are subject to biases and limitations.

*Post Session Evaluations.* Conference goals included a shift in practitioner proclivity toward data literacy instruction, awareness of its importance, and commitment to integrating data literacy instruction. Therefore, questions were developed to gain valuable insights from participants regarding their experience with the session they attended. The post session forms asked participants about adopting and implementing ideas from the webinar into their classroom through three open-ended questions: how likely are you to adopt an idea from this webinar into your classroom; as a result of this webinar in particular, I feel...; and what "aha moments" did you have during this webinar. The post session evaluation was administered after each hourlong conference session through a link to a Google Form provided by the session moderator. Year 1 had 11 sessions, and Years 2 and 3 had eight. Participation in the post session feedback was voluntary.

### Data analysis

All demographic data was analyzed in SPSS utilizing descriptive statistics. Inductive thematic content analysis was conducted to analyze the responses to the open-ended questions to discover participant perceptions of data literacy and its importance to students. Data was entered into NVivo and frequency queries were run to identify basic patterns in responses. Then the researchers became familiar with the data, making notes and memos of topic headings on the responses to describe the manifest and latent aspects of the content for each question. The codes were then grouped according to similarity under higher order themes and assigned themes (Braun & Clarke, 2006). This thematic analysis shifts the researchers' focus away from quantitative counts of words and phrases to "focus on identifying and describing both implicit and explicit ideas within the data" (Guest et al., 2012, p. 10). This same process was followed with each of the three open-ended questions from this section of the survey for all three years of the project.

The same inductive thematic content analysis procedure described above was followed in analyzing the post session response forms for all three years of the project.

## RESULTS AND FINDINGS

The analysis revealed several findings that have implications future iterations of professional development for educators and librarians around topics of data literacy. An unanticipated finding was the breadth and diversity of registrants given that conference designed for high school educators and librarians. Secondly, the data revealed trends in how participants scoped and defined data literacy over time. Third, respondents frequently did not make concrete connections between data literacy concepts and specific units of study or learning standard. Results are reported according to the major findings.

### Demographics: Unexpected attendees

In examining the data from all participants, it was notable that the target audience (HS librarians/educators) comprised a minority of registrations through the duration of the project. The range and breadth of careers in the registrations was surprising: most notably, the target audience of HS librarians and educators was only a small fraction of overall registrations: 201 or 41% in Year 1; 130 or 21% in Year 2; 129 or 21% in Year 3. This finding is an indication that other careers have similar need for data-themed PD. For example, academic librarians made up 11.5% of 2016, 28% of 2017, and 24% of 2018 registrants. This is compatible with the simultaneous growth in data literacy, data science, or research data management needs at colleges and universities, but also shows that basic data literacy needs are surprisingly similar across library types.

Other professionals that attended included teachers from various grade levels K-12, school administrators, instructional technology specialists, and school district personnel. While the majority of K-12 educators/school librarians that attended were serving at the middle (6-8) and high (9-12) school levels, about 15% of attendees each year were at the elementary (PK-5) level; this is consistent with K-12 standards and the recognized need to begin teaching these skills, just as other literacies, at the elementary level.

### Practitioner definitions and perceptions of data literacy

Responding to open-ended questions, all of the registrants shared definitions and perceptions of data literacy and its importance to students and their content

areas. These questions were examined to address the project goal relating to the perceptions of all of the participants' current awareness of data literacy and its importance for students.

The thematic analysis of each question resulted in emergent themes. For the question "What is your definition of data literacy?" emergent themes included: abilities to read charts and infographics; interpret data (analyze, understand, make meaning); use (apply, manipulate) data correctly for some purpose (as evidence); create representations of data to communicate/share information (presenting, displaying); "read" data (decode and understand what data and statistics mean in authentic contexts); evaluate data (bias, credibility, validity, reliability); locate, collect, gather data; use data ethically; and understand misuses of data.

One notable finding here was the prevalent understanding of data literacy as reading/using infographics. Also surprising was the lack of mention of statistics, which did not emerge as a theme. Also of interest is the mention of "reading data," which can most likely be attributed to K-12 standards, most notably the increased emphasis on reading nonfiction in both English Language Arts and the content areas in the Common Core State Standards (CCSSI, 2010).

**Lack of concrete connections to content area curriculum**

Emergent themes from the responses to "Why is data literacy important in your content area?" were: students need skills to be information literate because data is information; students need this skill for doing research; data literacy is important across all content areas; students need to know how to evaluate and interpret data; students need to know how to use data accurately to meet stated goals; students need to know how to create and communicate/share data; and because students need this skill for everyday use in life. The responses from all of the participants did not provide the content specific data that we were hoping to get; most participants noted why data literacy is important but did not connect to specific curricular standards or units of study. It was anticipated that participants would connect the virtual conference session topics to existing curricular units of study. For example, there were several sessions about personal data management, privacy, and online behavioral data trails since this was found to be an area where students lack knowledge (Acker & Bowler, 2018). The hope was that participants would connect principles of online privacy to existing digital citizenship curriculum that is generally, but not always, considered the librarian's purview. Similarly, while the social studies curriculum standards identify different types of data (e.g., demographic, economic, or social science data) used by various types of social scientists, participants did not state that the knowledge they gained in the sessions helped them strengthen how they addressed these concepts and practices in their curriculum.

While not a theme, many mentioned using data themselves for tracking student progress and for program evaluation, rather than students using data. These responses likely came from participants from K-12 school administration and higher education.

In Year 2, the conference occurred seven months into the new Presidential administration, when significant mainstream media coverage and professional conversations were considering both technical and political definitions of "fake news." This "fake news" trend highlighted the importance in educating students to interpret, understand, and comprehend data for decision-making (Johnston & Jacobs, 2017). While key themes remained consistent, there was an increase in the use of the term "fake news" and the need for students to be able to interpret data used in the media from the previous year, which is not surprising due to societal zeitgeist.

In Year 3 the same themes were present, but a new theme emerged: students need to be taught about personal data and privacy. This new theme is consistent with societal concerns at the time, e.g., data breaches and media coverage of personal data privacy concerns, particularly the Equifax data breach (Bernard et al., 2017) and the Facebook/Cambridge Analytica revelations (Cadwalladr, 2020), both of which occurred between the Year 2 and 3 conferences.

The third question asked all participants to: "give an example of a real-world situation where your students would need to be able to interpret data to make a decision". The emerging themes were: academic research projects; financial decisions; voting decisions; college and career decisions; understanding health/medical data; and interpreting their own test scores. In Year 2, there was a large increase in talking about using data to make voting decisions from the previous year; this was expected given data was collected less than a year after the 2016 Presidential election. In Year 3, a new theme emerged, understanding and interpreting data presented in the

news, again a reflection of and response to current events.

While the underlying principles and practices outlined in the project remained important, what is significant here is the growing importance of the societal context surrounding the project.

**Growing understandings of data literacy**

To address the project goal of shifting practitioner proclivity toward data literacy instruction and the commitment to integrating data literacy instruction, all of the attendees who had attended previous years were asked a series of questions about knowledge gained and implementation. These data along with the post-session feedback surveys were analyzed to assess the influence of the project on school librarian educators and data literacy instruction. In Year 2 (2017) of the project, 52 (10%) of participants had attended the virtual conference in Year 1. In Year 3, 70 (11%) of participants said they had attended either the 2016 or 2017 virtual conferences.

We asked these repeat participants the following: "How did your definition or understanding of data literacy change as a result of the 2016 and/or 2017 Virtual Conference?". In Year 2 we gave them multiple choice responses with the following results: 19 participants or 36% expressed that their definition or understanding of data literacy had increased/expanded/enhanced from attending a previous conference; 19% or 10 participants felt that they needed more knowledge or had no change, while 23% or 12 participants conveyed they had gained ideas for the teaching of data literacy. Eleven repeat or 21% of participants did not answer this question. In Year 3, in order to get richer data, we changed this question to open response.

Responses from participants included, "Deepened and expanded my knowledge/definition about data literacy is and the different aspects" and two responses directly related to data literacy instruction, "A better understanding of the importance of teaching data literacy" and "Opened my mind to better strategies and methods for teaching data literacy."

**Collaborating with the school librarian**

The next two questions were for repeat attendees. They were related to collaboration with a school librarian in their building. Participants were given three choices: (1) "No, and I do not have a school librarian in my building; (2) No, but I do have a school librarian in my building; and (3) "Yes." Response rates were very low on these questions in both Year 2 and 3, with only a 13-14% response rate. Again, this may be attributed to the low percentage of repeat attendees that were K-12 educators. Less than 1% (4 participants) stated that yes, meaning they had worked with their school librarian to implement something they learned. These four described various activities they had done with the school librarian, such as instruction on research skills, using databases to access quality data, and utilizing data visualization tools. The small response rate makes it difficult to draw further conclusions, but it is worthy of note that the majority of respondents did not work with their school librarian.

**Intention for implementation**

Two questions asked repeat attendees for specifics on how they had implemented what they learned: "Have you incorporated any statistics, data visualization, or data comprehension strategies into your instruction this year?" and "Then please share your experience integrating statistics, data visualization, or data comprehension strategies into your instruction this year." In Years 2 and 3, results were almost equally divided, with 42% (22 participants) and 45% (32 participants) stating that they had not incorporated any of the strategies into their instruction and 50% (26 participants) and 44% (31 participants) stating that they had; less than 1% of participants each year did not respond. This is not surprising due to the number of attendees that were not practicing educators; in Years 2 and 3 only 50% of the repeat attendees were K-12 educators. When sharing experiences integrating into instruction, the repeat educator participants shared that they had developed lessons for various content areas such as math, science, and information literacy instruction, and had taught lessons on data visualizations; notably, infographics were mentioned in over half the responses.

Links to post-session feedback forms were given to participants after each session in all three years (eleven in Year 1, eight in Year 2, and eight in Year 3) to gain insights on participants' thoughts on specifically using and integrating what they learned in each session. Participants were offered the incentive of a free six-month Easel.ly Pro subscription and entered into a drawing for free books for filling out the feedback forms. Session participants were first asked: "How likely are you to adopt an idea from this webinar into

your classroom?" and given multiple choice responses of "extremely likely, somewhat likely, neutral, somewhat unlikely, and I do not plan to implement anything from this webinar." In all three years, the session responses indicated a high percentage of the likelihood of implementation, with extremely likely and somewhat likely combining to be above 80% and somewhat unlikely and "do not plan to implement" all falling under 2%. This finding is an important one because sessions were developed with practical implications in mind in order to give attendees strategies and ideas for immediate implementation.

**Confidence builds quickly**

One of the challenges this project sought to address is the data confidence of school library educators; therefore, participants were asked about their confidence in their data literacy skills after each session. Again, the results across the three years of data collection demonstrated that these sessions did inspire participants' confidence: at least 70% of responses stated they felt "more confident" about their data literacy skills after sessions.

The question that asked participants if they had any "aha moments" during the session provided valuable insight into the changing perceptions of the participants. The following themes related to instruction emerged: enthusiasm for data repositories and free access to reliable data; appreciation for shared strategies, examples, and methods for teaching data literacy; real-world classroom examples and strategies helpful for anticipated future implementation; recognition of the connection of data literacy to information literacy; awareness that these are skills students need, but are not equipped with; and that data literacy is not solely about statistics.

Collectively, the results and findings point to numerous opportunities for future research, support for educators, and pedagogical practice.

## DISCUSSION AND IMPLICATIONS

Data literacy as a needed skill and not merely a curiosity came into focus parallel with unfolding current events.

The need and enthusiasm for data literacy education is strong, and this data shows that there is a critical mass of K-20 librarians and educators interested in data literacy, with needs, urgency, and plans for implementation becoming more focused as time passes.

**Need for data literacy support**

In Year 1 of the conference, the top choice for why the respondent was attending was curiosity, followed closely by, "I see students and teachers misusing data." Data literacy as a student need and not merely a curiosity came into focus parallel with unfolding current events in later conferences. Future professional development events might do well to engage participants around exercises and activities that awaken participants' curiosity and enthusiasm, framing data literacy not as a dry set of statistical practices but as an adventurous journey into comprehension and action.

The volume of registrations and variety of self-reported job titles, almost 80, points to both interest and need. While the percentage of attendees who were the target audience of HS librarians was low, it is worth noting an average high school might have 100 or more faculty members and only one or two librarians. The participant demographics indicate a broad need for data literacy education presented in an accessible, budget-friendly format, with materials tailored to specific grade levels and curriculum areas.

Approximately 70% of conference attendees said they were more confident after the conclusion of an online conference session than before. While this reflects well on the sessions, future research might explore whether attendees have acquired a depth of understanding commensurate with the growth in confidence. In the short-term, it appeared in observation that small knowledge gains increased eagerness and openness to new learning. However, might rapidly-gained confidence actually lead to overconfidence due to lack of understanding of nuance? This study is unable to answer that question.

Similarly, future research might explore the connection between confidence and future implementation. The data for Years 2 and 3 saw a small increase in actual implementation of data literacy practices, resources, or strategies among returning attendees though the numbers were close to evenly split between those who did and those who did not. This may be due to slight programmatic shifts in progressive conference years. Year 1 focused on the most intellectually rigorous data literacy themes: basics of data and statistical literacy, strategies for creating and interpreting data visualizations; and dissecting how data is used, misused, or underused in reading and writing arguments. Year 2 had a more personal focus: personal data management and personal data privacy practices; ethical use of data, a bedrock principle of librarianship;

and Big Data practices. Year 3 combined all themes, with an emphasis on Year 2's more personally-focused themes, an explicit and detailed discussion of user-friendly data tools that helped concretize and give confidence to novice data users.

For a project designed to define a potential landscape for data literacy among school librarians, this level of implementation is a good start. Another possibility is what Irving describes as "digital holidaymaking" (Brown, 2007, para. 1), a phenomenon in which educators attend professional development learning activities, participate actively and positively, and then return to their established practices upon return to the classroom. Given that lifelong learning is a hallmark of motivated educators and librarians, it is possible that attendees registered for personal enlightenment rather than professional growth.

**Need for easy-to-implement pedagogical tools**

Data literacy tools, materials, and resources exist and should be more accessible than ever via the Internet to educators. However, finding those materials may be challenging for time-strapped educators and librarians. Research from the academic (university) library field found that locating data is a source of frustration for professors, along with rapidly-changing sources, time, and no existing collection of data resources (Hogenboom et al., 2011; Kross & Guo, 2019; McBurney & Kubas, 2019). Similarly, K-12 teachers struggle to find and integrate appropriate instructional resources (Johnston, 2018; U.S. Department of Education, 2017), something made evident to the public when K-12 schools pivoted online due to COVID-19 (Adams, 2020).

Merely creating tools and materials is insufficient if we are to convince time-strapped educators and librarians to add data literacy instruction into already-busy schedules. Thoughtful selection and curation of those materials that are organized by discipline, curriculum standard, or theme could reduce the amount of pedagogical preparation and add to the novice data instructor's confidence. A potential model is the Library of Congress's Teachers site (n.d.), which organizes primary sources around instructional themes and includes preselected primary source resources, a teacher's guide, and student handouts and worksheets. A "push" model by which materials are delivered to educators, not merely posted in hopes that they are found, might also increase adoption. An existing model is the U.S. Census's Statistics in Schools program (n.d.), whose emails tie Census publications and data to premade, easily-understood seasonal activities. As teacher and librarian confidence grows, they will seek out less-packaged content, but using third-party instructional materials has been posited as a way for school librarians to develop new instructional partnerships with classroom teachers (Moreillon, 2009).

It is also important not to silo these resources at individual institutions but to make them accessible where K-12 educators and librarians actively search for materials. Many librarians are already doing this aggregation with web pathfinders like LibGuides, web templates that librarians populate with library holdings or online resources around a given discipline or topic. But this puts the onus on librarians, many of whom are still learners themselves, and consumes time that could better be spent collaborating with classroom teachers or instructing students.

A more pragmatic method might be to host quality data literacy resources on sites that mainstream educators flock to already, such as Pinterest and TeachersPayTeachers.com. Data repositories and providers can also leverage librarians' institutional insight by including them in dissemination plans. School librarians understand the landscape of their school's curriculum and can help get the right information to the right instructor at the right time.

**Focus on implementation barriers for existing data literacy standards**

In June 2019, Tuva Labs and the Educational Testing Service convened corporate, academic, K-12, and other parties invested in data literacy education. The session's operational assumption, "Is there a need for data literacy standards?" was that once something is tested, schools and educators are pressured to implement. Their assertion was weakened by the fact that data-related standards already exist (Colby, 2017; Lennex, 2016), raising the question about whether curriculum reform could effectively be driven by standards. Therefore, it is curious that meeting existing standards did not emerge as a point of interest for our participants, while infographics, absent in national standards, did. It is unclear whether infographics were the respondents' only known use for data and statistics, external forces were pushing educators to create infographics, or simply whether infographics have become "cool tech." Also surprising was the limited mention of statistics, indicating that the visualization of data, such as an infographic, may be more prevalent in the minds of

educators than the meaning or use of the data itself. Given the wide range of respondents' job roles, including supervisors at the district or state level, where adherence to specific standards is often articulated as a key instructional priority, the absence is particularly noticeable.

One pragmatic possibility is that there are simply more academic standards than any educator can substantively address and that educators are prioritizing standards over data standards that would require instructors to gain more skills to teach (e.g., Schmoker, 2017). Another possibility is that respondents are not well-versed enough in the standards to articulate them on the fly, especially during summer months away from school. Again, the responses point to the possibility that educators and librarians might benefit, as data novices, from curated learning modules and expertly-curated resource collections to facilitate integration.

## CONCLUSION

The results from this research reveal both an interest in and growing urgency for data literacy and gives us a glimpse into the needs and priorities of K-12 practitioners and others. However, the results open new avenues for discovery. For example, to what degree are classroom educators being connected to resources or coached in meeting data-related standards beyond math and science classrooms? What is the role of the school librarian in articulating these connections? To what degree does increased confidence lead to increased implementation? To what degree would a similar set of professional learning materials be satisfactory to diverse audiences? And finally, what are real-world examples of school librarians taking the lead in data literacy? A follow up area specific to this research is the extent to which the school librarian participants shared what they learned with the teachers the work with.

As students' lives are increasingly driven by social media algorithms, targeted advertising, data-infused arguments, and large-scale data collection, the need for increased inquiry into how we support classroom teachers and librarians remains critical.

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