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Examination of State-level School Safety Data Dashboard Characteristics

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Abstract: Choices made on data visualizations guide how users make meaning of the information presented. This research investigates design decisions made on 115 state-level dashboards reporting school safety data. Using pre-determined codes drawn from a framework of visualization rhetoric, dashboard characteristics were described and analyzed. Analysis demonstrates that school safety dashboards vary significantly in types of school safety data included as well as how such data are presented. Most dashboards lack specific interpretative text or narration, meaning the messages and stories communicated by dashboards are influenced largely by choices in data included, how it is visually represented, and the interactivity provided to users. The choices craft divergent stories about school safety for dashboard users—including, but not limited to, those that foreground student behavior as the central threat, those that present school practices as problematic, and those that center

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community creation—which may shape public discourse around school safety. In concert, rhetorical choices reflect different perspectives on safety, students, and schools.
Keywords: dashboards; school safety; data use; data visualizations; education dashboards

Análisis de las características del panel de datos de seguridad escolar a nivel estatal
Resumen: Las elecciones realizadas en las visualizaciones de datos guían cómo los usuarios dan sentido a la información presentada. Esta investigación investiga las decisiones de diseño tomadas en 115 paneles a nivel estatal que informan datos de seguridad escolar. Utilizando códigos predeterminados extraídos de un marco retórico de visualización, se describieron y analizaron las características del panel. El análisis demuestra que los paneles de seguridad escolar varían significativamente en los tipos de datos de seguridad escolar incluidos, así como en la forma en que se presentan esos datos. La mayoría de los paneles no tienen texto interpretativo ni narración específica, lo que significa que los mensajes y las historias comunicadas por los paneles están influenciados en gran medida por las opciones de los datos incluidos, cómo se representan visualmente y la interactividad proporcionada a los usuarios. Las opciones crean historias divergentes sobre la seguridad escolar para los usuarios del tablero, incluidas, entre otras, aquellas que resaltan el comportamiento de los estudiantes como la amenaza central, aquellas que presentan las prácticas escolares como problemáticas y aquellas que centran la creación de comunidad, que pueden moldear la situación pública. discurso en torno a la seguridad escolar. En conjunto, las opciones retóricas reflejan diferentes perspectivas sobre la seguridad, los estudiantes y las escuelas.
Palabras-clave: paneles; seguridad escolar; uso de datos; visualizaciones de datos; paneles educativos

Análise das características do painel de dados de segurança escolar em nível estadual
Resumo: As escolhas feitas em visualizações de dados orientam como os usuários dão sentido às informações apresentadas. Esta pesquisa investiga decisões de design feitas em 115 painéis de nível estadual relatando dados de segurança escolar. Usando códigos pré-determinados extraídos de uma estrutura de retórica de visualização, as características do painel foram descritas e analisadas. A análise demonstra que os painéis de segurança escolar variam significativamente nos tipos de dados de segurança escolar incluídos, bem como na forma como esses dados são apresentados. A maioria dos painéis não possui texto interpretativo ou narração específica, o que significa que as mensagens e histórias comunicadas pelos painéis são influenciadas amplamente pelas escolhas nos dados incluídos, como são representados visualmente e pela interatividade fornecida aos usuários. As escolhas criam histórias divergentes sobre a segurança escolar para os usuários do painel—incluindo, mas não se limitando a, aquelas que destacam o comportamento do aluno como a ameaça central, aquelas que apresentam as práticas escolares como problemáticas e aquelas que centralizam a criação da comunidade—o que pode moldar o discurso público em torno da segurança escolar. Em conjunto, as escolhas retóricas refletem diferentes perspectivas sobre segurança, alunos e escolas.
Palavras-chave: painéis; segurança escolar; uso de dados; visualizações de dados; painéis educacionais

Examination of State-level School Safety Data Dashboard Characteristics

Interactive data dashboards, organized and graphic virtual data displays designed to help users make sense of large sets of information, have become commonplace in educational spaces (Lawson-Body et al., 2022; Sarikaya et al., 2019). While many dashboards track individual student progress for the student, teacher, and/or guardian, other dashboards aggregate institutional data for public consumption into systems-level dashboards that display data from a group of schools, e.g. school district or state. Many states and other entities host public-facing dashboards that allow for easy visualization of school report card style data as part of accountability systems (Lingard et al., 2017), and some school systems offer dashboards to assist parents with school choice decisions (Curran et al., forthcoming).

However, such public displays of school data through dashboards have not been without controversy. For example, schools in Denver, Colorado engaged in a several year process and debate over the merit of a public dashboard, before an external organization created one instead (Asmar, 2024). This was despite state-wide legislation that required public posting of school data, including that around discipline, by 2024 (Colorado General Assembly, 2022). Many stakeholders were concerned that public displays of school information might result in unintended consequences, with one school board member stating that parents might "weaponize" the data (Asmar, 2024). Indeed, there are examples of public attention to school data costing leaders their jobs and leading to school closures (Dowdall, 2011; Kim, 2023). On the other hand, however, advocates have argued for the importance of informing parents and providing information to inform their decision-making. Prior work suggests that stakeholders desire access to understandable measures about school performance (Curran et al., forthcoming). These competing positions, then, suggest the importance of attention to the data displayed in dashboards and the stories communicated through choices about how to display it.

K-12 schools and systems make use of dashboards largely to trace and report academic performance metrics, but they have increasingly also included data that provide information about the school context and report non-academic outcomes (Curran et al., forthcoming). Among the information reported is data related to school safety. For example, a dashboard might offer information about school climate—the perceptions held by various stakeholders about the school environment regarding safety, social interaction, relationships, values, and beliefs that contribute to safety (Bradshaw et al., 2014; Rudasill & Snyder, 2018). Other school safety topics identified in recent years by the U.S. Departments of Education and Justice, shared through the SchoolSafety.gov clearinghouse, that might be reported through a state-level data dashboard include bullying and cyberbullying, cybersecurity, emergency planning, infectious diseases and public health, mental health, targeted violence, and threat assessment and reporting.

Purpose

State-level dashboards invite a wide audience to view and interpret data through visual and interactive displays. Design decisions guide not only what data are available but what questions readers ask of the data, how they interact with the data, and what meaning they make of the knowledge they glean. We are interested in how these dashboards help shape important ideas in school safety including how safety is conceived, which school safety concerns and measures are worthy of attention, the importance of school safety, and suggested safety solutions and mitigation efforts that should be explored. These messages may be explicitly or implicitly communicated through dashboard design and may have particular implications for subgroups of students, including racial minorities, who tend to feel less safe at school and are

disproportionately likely to have their behavior interpreted and responded to in punitive ways (Kupchik, 2010; Losen, 2014; Viano & Truong, 2022).

This study aims to identify and describe both common and exceptional design features in data dashboards that include state-wide K-12 school safety-related data—defined broadly to include elements aligning with SchoolSafety.gov's 2023 categories of safety topics and including both dashboards maintained by state governments, but also state-level dashboards created by other entities. The study was guided by the following research question:

1. What are the characteristics, i.e., included metrics, visual presentation, and functionality, of state-wide school safety related data dashboards?

Answering this question could contribute to the ongoing design and implementation of state-wide school safety dashboards and inform how existing dashboards may be shaping public discourse around school safety. Specifically, through our findings and discussion of example dashboards, we illustrate how these design choices may shape ideas about school safety through implicit and explicit stories communicated through the dashboards.

To preview the findings, our analysis demonstrates that school safety dashboards vary significantly in the types of school safety data included as well as how such data are presented. Most dashboards lack specific interpretative text or narration, meaning the messages and stories communicated by dashboards are influenced largely by rhetorical choices in data included, how it is visually represented, the interactivity provided to users, and the assumptions and interpretations of end-users. We illustrate this phenomenon in our discussion through three examples of dashboards whose data and design choices potentially lead to different interpretations of similar underlying data. With these findings highlighted, we turn next to an overview of school safety, systems-level dashboards, and the intersection of the two.

Background

Fears about school safety have grown substantially (Brenan, 2022; Kupchik et al., 2015; Swanson et al., 2019) even while rates of school crime and student victimization were at historically low rates (Irwin et al., 2022; Musu et al., 2019). These fears, however, are often driven in part by a focus on particular types of events, such as mass casualty school shootings (Burns & Crawford, 1999), or on anecdotal sources of evidence that are not representative of school safety more broadly. Scholars have argued that media coverage and responses of the public and politicians have contributed to such fear (Burns & Crawford, 1999). While there is some variation in perceptions of safety and fears of particular acts of school violence across geographic regions and demographic subgroups of the population (Elsass et al., 2021; Lacoe, 2015; Viano & Truong, 2022), concerns over school safety in at least some form have arguably become a transcendent aspect of schooling. This has perhaps only grown in the past several years as families navigated public health school safety concerns during the COVID-19 pandemic and subsequent reports of rising misconduct and violence in schools in the several years that have followed (National Center for Education Statistics, 2022).

The intuitive fear for children in schools has, in part, led to safety decision-making shaped by hazard qualities that do not speak to the risk level posed but instead speak to feelings about the hazard, e.g., newness, immediacy, and unforseeability (Fischhoff et al., 2000; Slovic et al., 2010). Cultural and other personal values also impact decision making. Individuals' experiences, race, ethnicity, and gender influence their perceptions of risk and subsequent decision making (Finucane et al., 2010; Gilbert et al., 2020; Mott Children's Hospital, 2020).

Some hazards receive much attention while others that are perceived to affect only certain groups, or to which we have become inured, fly under the radar. Public facing dashboards designed to include school safety metrics could respond to both the rise in fear and the challenges of safety decision making by providing wider access to comprehensive school safety data.

K-12 Dashboard Design

Dashboards often serve as a means by which "comparative performance data are now made publicly available" in response to the push for "top-down, performative" accountability measures for public schools (Lingard et al., 2017). The Elementary and Secondary Education Act of 1965 (ESEA), as amended by the Every Student Succeeds Act (ESSA), requires states that receive Title 1 funds to publish report cards informing the public about the state's overall school performance and the performance of the districts and schools within the state (ESEA 1965, section 1111(h)(1)(A)). Though these report cards do not need to be in the form of a data dashboard, many states are opting for these interactive publications. Additionally, the COVID-19 pandemic saw a rapid deployment of public facing dashboards designed to publicly report cases, vaccination rates, and the availability of virtual and/or in-person school options (Li & Yarime, 2021). In the United States, these COVID-19 dashboards often included school specific data, evidence that dashboards function to fill a demand for information as parents made decisions about their students' safety. These dashboards all add to the burgeoning landscape of dashboards addressing policy issues (Li & Yarime, 2021) and used in education spaces (Schwendimann et al., 2017).

Federal guidance suggests that the state school report cards be concise, easy to understand, accessible for people with disabilities, and in multiple languages "to the extent practicable," advice that leaves room for many visualization and presentation decisions (U.S. Department of Education, 2019, p. 9). This freedom allows states to craft a publication that tells a story from their perspective about schools and students. Most of the data required by the federal regulations speak most directly to academic achievement, e.g. test scores, graduation rates, post-secondary enrollment. The only requirement for safety specific data is to include "information collected and reported in compliance with the Civil Rights Data Collection" (U.S. Department of Education, 2019, p. 15). CRDC data include disciplinary information disaggregated by race/ethnicity, sex, limited English proficiency, and disability. Of course, school safety related dashboards outside of the state report cards need not meet even the light constraints of the ESSA guidelines and are even more free to craft the story being told by the data they display.

Reviews of the available research on formal K-12 school systems-level data dashboards reveal a dearth of research about their design (Bodily & Verbert, 2017; Curran et al., forthcoming.). More specifically, public facing dashboards, rather than those designed for educators' use, and dashboards centered on non-academic outcomes have received little research attention (Schwendimann et al., 2017). In a systemic review of research on data dashboards from formal K-12 systems, Curran and colleagues found that studied dashboards largely focus on academic accountability but sometimes do include data about other topics, e.g., wellness policy and school spending. Further, several studies identified problems with providing only narrowly conscribed academic accountability data, problems that should be remedied with "additional metrics…and richer contextual data" (Curran et al., forthcoming, p. 25). However, balancing that call are concerns that too many metrics in a dashboard can confuse and complicate the user

experience. Selecting which data to include and exclude begins the value-laden design decisions behind a data dashboard.

Despite a lack of systematic evidence on school safety dashboards, many organizations have begun using dashboards to communicate school safety data. For example, the popular website Niche.com, which provides data profiles and ratings of schools nationwide, includes a "Culture and Safety" category which presents results of polls of students about their feelings of safety. Similarly, the federal government and some states include school safety data in public-facing systems-level dashboards, including that in the federal Civil Rights Data Collection. Such dashboards allow stakeholders to view discipline data and infraction data among other indicators of school safety.

In recent years, several non-governmental organizations have begun developing school safety dashboards. Prominent among these, the non-profit Safe Schools for Alex, which was founded by the father of a victim in the 2018 Parkland school shooting, has undertaken the development of school safety dashboards in at least five states using publicly available school data. These dashboards have been endorsed by political leaders and the former US Secretary of Education and have been used by school districts and other stakeholders to inform school safety decision-making. For example, in the state of Florida, the state's Department of Education previously directed schools to use the Safe Schools for Alex school safety data dashboard in the creation of their school improvement plans, resulting in goals and plans that were directly based on review of a school safety data dashboard (Florida Bureau of School Improvement, 2021). Despite the emergence of school safety data in existing dashboards and new dashboards that are specific to school safety, there has been relatively little empirical research on the design and content of school safety dashboards at scale. Given the ongoing focus on school safety following continued acts of gun violence, there is an expectation that more states and stakeholders will be interested in presenting and using school safety data. As we describe next, this paper addresses this limitation of the existing literature by systematically examining data dashboards that include school safety information.

Theoretical Perspectives

State-level school dashboards are worthy of study because data dashboards' "potential for impact is vast" (Sarikaya et al., 2019, p. 682). Designed to drive decision making, school dashboards monitor and track people and processes in many dimensions and at all levels of measurement, student, class, grade, school, district and beyond. Their influence, therefore, could include both intended and unintended impacts on academic and non-academic outcomes. State-level school dashboards vary greatly from state-to-state in content, visualization, and interactivity (Curran et al., forthcoming). As the age of big data evolves, "dashboards are likely to become more important" and have the potential to "play a crucial role in providing insights into a situation and helping the situation to improve and evolve" (Matheus et al., 2020, p. 7). However, data scientists contend that many dashboards are not useful, whether because they display too much information, too little, or do so in a way that does not allow users to make actionable decisions (Few, 2013; Janes et al., 2013).

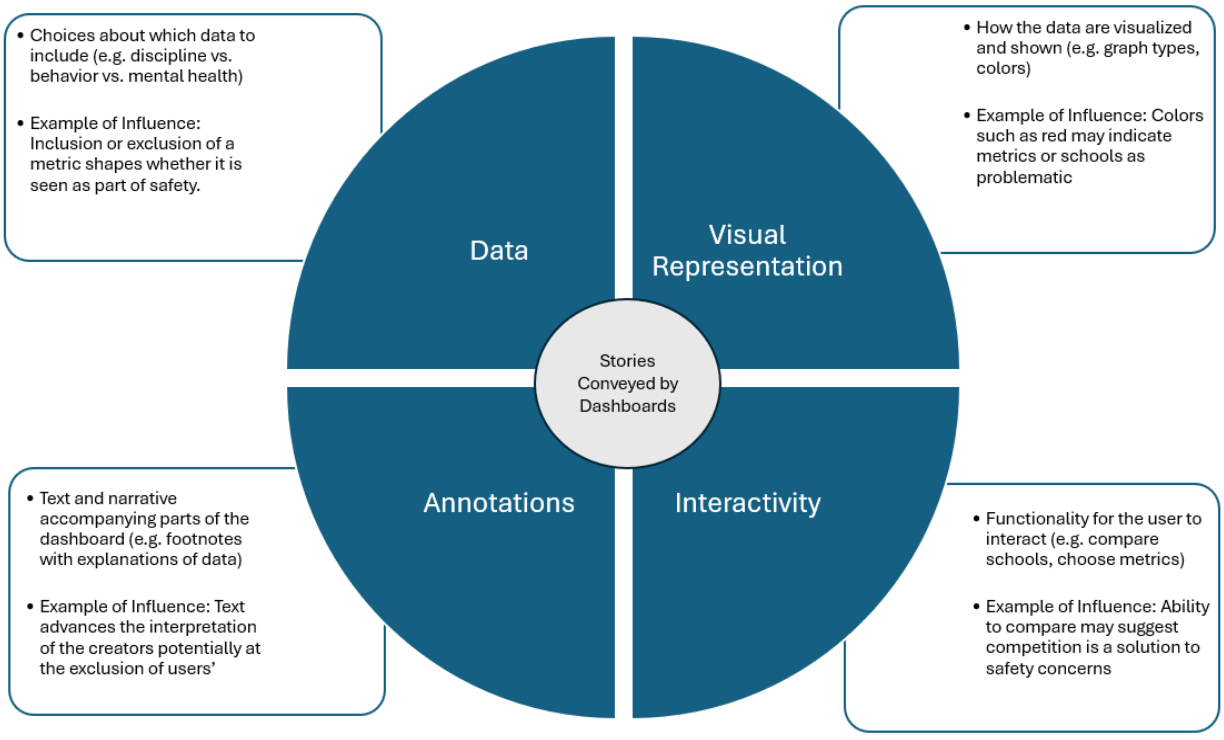
Dashboard creation involves a series of design decisions each of which represents a "sequence of choices" or "editorial judgements" (Hullman & Diakopoulos, 2011, p. 2233) that influence how the data are presented and perceived. Data reporting through charts and tables often suggests to readers objectivity and neutrality, "direct representations of facts unmediated by the artificial lens of design" (Kostelnick, 2004, p. 225) when in fact design decisions have great impact on interpretation of data (Hehman &Xie, 2021; Hullman & Diakopoulos 2011; Midway 2020; Tufte 2001). In other words, dashboards craft a narrative through a series of choices about what and how

information is presented (Jarke & Macgilchrist, 2021). In education spaces, these stories impact policies and decisions that influence student experiences. Research on public reports of school performance ratings, for example, point to their influence on leaders' staffing and curricular decisions (Lee & Lee, 2020) and, at scale, a tendency to deepen inequalities within schools and the surrounding communities (Hasan & Kumar, 2024).

We structure our discussion and analysis of school safety dashboards through a framework – termed "visualization rhetoric" - for categorizing and interpreting design choices. In describing visualization rhetoric, Hullman and Diakopoulos (2011) suggest viewing data visualizations, like dashboards, through four editorial layers of design each of which requires judgements and offers opportunities for rhetorical techniques to shape the story told by the data (see Figure 1). The first layer, "data", involves choices about which data, data sources, and variables to represent. This layer also sees critical decisions about the exclusion/inclusion of outliers, scaling, and how data are aggregated. The second layer, "visual representation" includes choices about color use, graph style, placement, and organization. The third layer, "annotations," involves design decisions about text, e.g., titles, captions, and explanatory notes. The final layer, "interactivity," involves choices about how the user will interact with the data, e.g., navigation menus, search limits, and suggested queries (Hullman & Diakopoulos, 2011). Examining the dashboards through this frame helps reveal underlying narratives about school safety that may shape user's perceptions of risks, schools, and students.

Figure 1

Visualization Rhetoric



Note: A model of four layers of design decisions that shape data dashboards and influence users' experience and interpretations, from Hullman and Diakopoulos (2011).

While evidence on the uses and theory of action behind public facing systems-level data dashboards in education are limited (Curran et al., forthcoming.), a broader body of literature suggests that data dashboards may serve several purposes and affect change through a number of different mechanisms (Zhaung et al., 2022). Dashboards are generally seen as a mechanism for informing data-driven decision-making in organizations, with the ability to visualize and easily access key performance indicators serving to guide organizational functioning (Limpinen, 2012). Public facing dashboards theoretically extend the groups that can engage in such decision-making while also introducing several other mechanisms of change. Public data dashboards may serve as one tool for communication with stakeholders. While such communication could be driven by largely compliance objectives (such as laws that require public disclosure of performance indicators), that does not subvert its potency or prevent data displays and dashboards from making rhetorical choices that guide engagement and collaboration efforts. In particular, publicly available data in dashboards will be subject to interpretation by users even in, and perhaps more so in, the absence of articulated goals and data narratives from the dashboard creators.

Through communication of public facing data, dashboards may increase public transparency of organizational (district or school) operations (Mannaro et al., 2018). While empirical evidence is mixed (Matheus et al., 2020; Porumbescu, 2015), government transparency has been theorized to increase trust in the governing body (Meijer, 2013). Ultimately, such transparency, while potentially increasing trust, may also empower stakeholders to hold schools accountable and may alleviate information asymmetries allowing stakeholders to make more efficient decisions. For example, the public posting of test scores or school grades and their use in decision making of parents in systems of school choice represent one such accountability driven mechanism of dashboard use (Polikoff et al., 2018; Robertson et al., 2022). Indeed, prior studies have found that providing information on high school acceptance and graduation rates, either directly to parents and students or through school counselors, can shape patterns of school choice decisions (Corcoran et al., 2018; Cohodes et al., 2023).

Prior research on dashboards outside of education demonstrates that the interpretation and use of dashboard data are dependent both on the context and background of users as well as the design choices of the dashboard itself. For example, studies have found variability in whether users find dashboards actionable, in part due to differences in what individuals perceive to be actionable and the personal ways users interact with dashboards (Curran et al., forthcoming; Sorapure, 2023). Other work has found that the frames used to present data on dashboards shape responses to and interpretations of the data (Gallagher et al., 2024). In short, then, the four editorial layers of the visualization rhetoric theory and prior empirical work demonstrate that dashboards do more than just present the facts, and instead the design, visualization, and interpretative choices of dashboards affect how they are used and the meaning users make from them.

Methods

The goal of this study was to identify the content and design choices of state (and similar jurisdiction-level) data dashboards that contained school safety data, broadly defined. We defined jurisdiction to include states, Washington DC, the five territories, and Bureau of Indian Education, and other federal dashboards. In contrast, dashboards created by or focusing on single districts or schools were not included. Our sample included both dashboards maintained by government entities such as state departments of education but also those created by other groups such as non-profits. We purposefully sought to document dashboards that included a range of safety information from fights to public health threats. We approached our work through a descriptive research design in which we searched to identify relevant dashboards and coded characteristics of these dashboards.

We then leveraged purposive analysis of three example dashboard cases to discuss the potential meaning and implications of different design choices.

We began our work by curating a collection of dashboards containing jurisdiction-wide (i.e., federal, 50 states, Washington DC, five territories, and Bureau of Indian Education) data from formal K-12 schools. We culled dashboard addresses from the jurisdiction level departments of education and from lists of "state emergency management resources" from Readiness and Emergency Management for Schools Technical Assistance Center (REMS TA) (https://rems.ed.gov/stateresources.aspx). We also conducted Google searches which helped make certain we captured jurisdiction-level dashboards hosted by agencies other than education departments and non-governmental agencies. For each jurisdiction, multiple researchers independently collected site addresses through Google searches allowing us to compare and compile a comprehensive list. Systematic review of grey literature through Google search requires strategic use of search terms and is dependent on relevancy rankings (Godin et al., 2015). To this end, we used a variety of search terms in various combinations, screened a set number of results pages (3), and had different researchers conduct the searches (i.e., double searching) to help minimize Google's "bubbling" effect (Godin et al., 2015; Piasecki et al., 2018). We do note that while our method was systematic, rigorous, and cross-checked, we can still not be certain we captured every dashboard that met our requirements, in part because Google search is an imperfect tool for systemized research (Piasecki et al., 2018). Google search terms included:

(jurisdiction) AND school data OR dashboard
(jurisdiction) AND school data AND dashboard
(jurisdiction) school dashboard AND covid
(jurisdiction) school dashboard AND infectious disease
(jurisdiction) school dashboard AND violence
(jurisdiction) school dashboard AND mental health
(jurisdiction) school dashboard AND school climate
(jurisdiction) school dashboard AND discipline

We then assessed whether it contained information about at least one of the safety topic categories from SchoolSafety.gov: bullying and cyberbullying (e.g., bullying offense data, social media monitoring reports); cybersecurity (e.g., data security reports, information about stakeholder training); emergency planning (e.g., traffic control data, safety drill data); infectious diseases and public health (e.g., data about COVID-19, tobacco offense data); mental health (e.g., number of students with accommodated psychiatric disabilities, suicidality reports); targeted violence (e.g., data about violent offenses); school climate (e.g., climate surveys, discipline outcomes data); and threat assessment and reporting (e.g., data about threats against the school, data about police actions).

If a dashboard met these criteria, its characteristics were independently described by two different researchers according to pre-determined codes drawn from a framework of the "editorial layers" of visualization rhetoric (Hullman & Diakopoulos 2011, p. 2233). Examples of these pre-determined codes include: "What categories of safety data are available?"; "Is the Dashboard updated?"; "Is there evidence of data ambiguity regarding any school SAFETY data, e.g., error measure, confidence interval, narrative note?"; "Is a historical trend available in one visual display? [for SAFETY data] (as opposed to looking up different data separately)." The dashboards were described in a Google forms document by both researchers independently and then all responses to the following codes were reviewed and differences were reconciled between the two coders. See Appendix A for all codes used.

With dashboard characteristics coded quantitatively, we conducted a further interpretative analysis of three specific dashboards in order to illustrate the potential ways in which design and content choices of dashboards might shape users' interpretation of school safety data and the implications that each might point to for policy and practice. The three dashboards were chosen purposefully for their display of very similar data but with varying design features and rhetorical choices in data display. We integrate discussion of school safety dashboard design into our interpretative analysis of these three dashboards to illustrate the potential implications of dashboard design choices for policy and practice.

Results

In the following section, we present the results of our analysis. We begin with a descriptive overview of the identified educational dashboards with school safety data. We then present the characteristics of these dashboards, organizing our discussion around the four editorial layers outlined in our theoretical framework (Hullman & Diakopoulos 2011, p. 2233). Specifically, we examine the data included, the visual representation of the data, the annotations or text accompanying data visualizations, and the interactivity of the dashboards.

Dashboards Overview

Our systematic search identified 115 dashboards which met our inclusion criteria, namely that they included school safety data focused on K-12 settings. All states and Washington DC had at least one dashboard which included school safety data, and we included five dashboards that presented national level data. However, the prevalence of dashboards varied considerably with 35 jurisdictions having more than one dashboard containing school safety data and three states (California, Connecticut and Georgia) each having five dashboards identified. The dashboards identified were predominantly developed and/or hosted by state departments of education (52.2%). Another 25.2% were associated with other governmental agencies, often departments of health, while 22.6% were available through non-governmental agencies, sometimes in collaboration with governmental agencies. Many of the dashboards were developed on common data visualization platforms such as Tableau and PowerBI, though the names of the actual design firms that used these platforms to create the dashboards were rarely available.

While most dashboards (76.5%) were updated with new data rather than representing a single time point, updates were generally annual, with notable exceptions for public health related (COVID-19) dashboards which were often updated at more regular intervals. Including all of the COVID-19 dashboards, 48.7% of safety data-containing dashboards emphasized safety data most prominently, rather than other concerns, i.e., enrollment, academic achievement. Emphasis was judged by weight of the safety metrics, placement, and size of the visualizations. The most commonly included safety data referred to school climate, e.g. data about climate surveys, absenteeism, and/or student disciplinary outcomes.

Qualitatively, the dashboards identified ranged from detailed and sophisticated presentations of safety data with robust comparison tools and information for users, to simple sites that presented only a few metrics in tables for perusal. For example, the treatment of school incident and discipline data differed considerably across dashboards. In Georgia, the Governor's Office of Student Achievement in their K-12 Student Discipline Dashboard presented for each school a colorful, clickable Sankey diagram through which users could connect incidents to disciplinary outcomes disaggregated by gender and race/ethnicity of the involved student. Conversely, The New York State Education Department in their school

profiles only reported the percentage of all students "suspended from school at least one full day during the school year" and offered a link to a collection of Excel spreadsheets that contained incident data and links out to the Civil Rights Data Collection for more complete school discipline data.

Half of dashboards nodded to ambiguity in their data encouraging users to remember the nuance needed to make meaning of the reported metrics. Simultaneously, a substantial portion of the dashboards (34.8%) summarized schools' performance through an applied qualifying descriptor of some kind like a letter grade, though not necessarily specific to safety.

In part because the dashboards in our collection were constructed for different purposes, we chose not to assess their quality relative to each other (i.e. we avoid labeling dashboards as "good" or "bad"); however, we describe their features as they map onto our conceptual framework and, through discussion of three specific dashboards, illustrate broader differences in the types of dashboards identified. We turn now to a presentation of the results that support these findings.

Layer 1: Data

The data-related layer of rhetorical decisions guiding dashboard presentations considers what metrics and variables are included. The most frequently included school safety related data spoke to school climate in some way, most often discipline data, absenteeism rates, and on eight dashboards (6.9%), school climate survey results (see Table 1). Most dashboards (55.7%) only contained data pertaining to one of the eight 2023 SchoolSafety.gov categories of safety, including all 29 COVID-19 dashboards. However, 22.6% of dashboards contained data that covered four or more school safety categories.

Table 1

Portion of Dashboards That Display Different Categories of School Safety Data

Category	*N*	%	Examples
School climate	78	67.83	School climate survey; chronic absenteeism; discipline consequences
Infectious disease and public health	49	42.61	COVID-19 cases; tobacco use
Targeted violence	41	35.65	Violent incidents
Bullying/cyberbullying	31	26.96	Incidents of bullying
Threat assessment and reporting	27	23.48	Police involved incidents
Mental health	10	8.70	Self-harm reports; access to counseling
Emergency planning	2	1.74	School Safety Plan review frequency; school facilities inspections information
Cybersecurity	1	0.87	Cyber harassment incidents

Dashboards also varied widely in how well data could be disaggregated for deeper analysis. Most dashboards (70.4%) offered data disaggregated into subpopulations of some kind, including 55.2% of the COVID-19 dashboards which often disaggregated case data by student and staff (see Table 2). For example, one of the most comprehensive school safety dashboards, the School Report Card from the Kentucky Department of Education, contained data on 14

disciplinary outcomes and 8 types of behavior events disaggregated by location and timing, all disaggregated into grade levels and by a collection of student sub-populations. In addition to this detailed incident and discipline data, the dashboard included school climate survey data that could be disaggregated by student sub-populations and precautionary measures taken by the school to protect student safety including prevention programs. While the Kentucky Report Card, like most dashboards (76.5%), included data from more than one point in time, it did not allow for the display of a trend over time.

Table 2

Frequency of Different Means of Disaggregating Data into Sub-populations

Sub population	*N*	%
Disaggregated in any way	81	70.43
Age or grade	27	23.47
Race	61	53.04
Gender	40	34.78
Economically disadvantaged	41	35.65
Special education identified	51	44.35
English language learners	43	37.39
Other: e.g., student/staff; housing status	31	26.96

Layer 2: Visual Representation

Layer 2 explores the decisions made about the appearance of the dashboards. Bar graphs were selected most frequently as the style of graph for depicting numerical data, followed by tables and line graphs (see Table 3). Though we did not quantify their appearance, many dashboards selected key metrics to highlight as large font tiles. The size and location of these data depictions made them prominent indicating that as a measure they held special significance (see Figure 2).

Table 3

Prevalence of Different Styles of Graph

Graph type	*N*	%
Bar	87	75.65
Table	73	63.48
Line	42	36.52
Map	36	31.30
Pie	21	18.26
Scatter	6	5.22
Pictograph	6	5.22
Other	19	16.52

While some were very colorful, on most dashboards color palettes were limited, with a preference for black, grey, and white punctuated by shades of a hue from the cool side of the color spectrum, e.g., blue or green. A few dashboards employed colors to signal something quantitative about the data, most often through color-scales on maps or the use of stoplight color schemes to signal numerical thresholds. In addition to data visualizations, other illustrations were present on almost all dashboards. A few dashboards included photos of young people or local landscapes, but far more included logos and graphic symbols as an additional way to communicate meaning (see Figure 2).

Figure 2

Tile of Emphasized Statistic with Graphic Symbol

Note: From https://projects.propublica.org/miseducation/

Layer 3: Annotations

The third layer of rhetorical decisions concerns annotations and text around visualizations. One key variable we investigated was whether dashboards indicated some possibility of ambiguity in the reported data. Almost half (49.6%) of the dashboards did not nod to the possibility of incomplete or errant data, nor did they caution users about the usefulness of data for making comparisons or drawing conclusions. Often (50.4%), however, dashboards did alert users to remember there were important nuances to understanding the data they reported. Five dashboards (4.3%) included this message within the graphic visualization itself, as with a scatterplot underneath a line of best fit or depicting a confidence interval. Far more common, however, were narrative notes accompanying graphs or prefacing data visualizations on an introductory page. For example, school climate survey data sometimes included a note about survey response rates, and several departments of education pointed out data collected in SY 2019-20 and 2020-21 were "affected by the pandemic" and that users should "keep this in mind when reviewing the data and take particular care when comparing data over multiple school years" (Massachusetts School and District Report Cards). Other common notes included notifications that some data were suppressed to protect the privacy of students when numbers were so low they might indirectly betray the identity of a student and notes that data reflected what was reported on a particular date.

We also examined whether the dashboards offered some qualifying label to schools or districts based on any data reported out on the dashboard, e.g., letter grades, pass/fail. Though it was rarely based on the safety data alone, and sometimes unrelated to the reported safety data, 34.8% of dashboards did apply some label to schools, akin to a summative metric by which to easily assess a school's success and compare school to school.

Through headings and titles, dashboards described data in ways that began to suggest how users might make meaning of the numbers reported. For example, climate survey results were variously described as related to school quality, school environment, learning conditions, engagement, and safety. However, very few of the dashboards examined provided substantive interpretation of the data or recommendations based on the data presented. In other words, while dashboards might show a particular school as having experienced an increase in an offense like bullying over time, the dashboards were unlikely to suggest why this increase was occurring (e.g. changes in behavior, changes in enforcement, changes in students served, changes in reporting requirements, etc.) or to point users toward potential responses/solutions to the change (e.g. evidence on effective bullying intervention programs). Thus, the dashboards were focused on the presentation of data, with the perceived meaning of the data shaped more by presentation choices rather than narrative annotations and the responses to the data left to users' discretion. This general lack of interpretative text or recommendations based on the data distinguishes dashboards from other mediums of safety data such as research reports or advocacy pieces that often couple data analysis with interpretation and recommendations.

Layer 4: Interactivity

The fourth layer of rhetorical decisions involves ways a dashboard invites users to interact with the data presented. We found that 16.5% of dashboards displayed a default example school or district in lieu of a blank search page or a summary of statistics for the entire jurisdiction, and 14.8% dashboards suggested a search query to users, often through a default selection in a drop-down menu of choices. For example, the Safe Schools for Alex Florida dashboard defaulted to displaying the Marjory Stoneman Douglas High School page, and when moving to the comparisons tool defaulted to comparing schools' (rather than districts) number of fighting incidents sorted by highest to lowest rate of incidents per 100 students.

Almost half (45.2%) of dashboards provided ways to compare school to school, and 42.7% allowed district to district comparisons in one visual display. For some dashboards this comparison required scrolling a long table, but other dashboards offered robust tools for creating comparisons. For example, the Mississippi Succeeds Report Card allowed users to personally curate a collection of schools for comparing across several metrics. Other dashboards offered cut scores or targets against which to measure a school's data, e.g., Connecticut Report Cards and California Report Cards. A few dashboards offered means of comparing similar schools. For example, Michigan Department of Education Report Cards reported school data compared to the state average and the average of a collection of schools with similar student populations or proximal geography.

Discussion

School safety dashboards' rhetorical choices have the power to shape risk perceptions about individual schools and the very concept of school safety itself (Peters et al., 2010). To illustrate the combined effect of different rhetorical decisions and their influence on narrative creation, we contrast three dashboards below that report out similar data about their respective jurisdictions. Each of these dashboards presented data about student behavior and disciplinary responses, but each for a different state and with a different goal in mind as revealed by their display choices. Together they illustrate the power of display decisions on data interpretation.

While the hosting organizations were doubtlessly responsible for many of the display decisions, we also recognize that some of these decisions were constrained by data collection decisions made by entities outside of the dashboard hosting organizations, for example gender

data are almost always binary, following CRDC requirements. Other constraints include those stemming from data visualization tools that limit design choices, for example whether a drop-down menu must be visualized with a choice option in the open field rather than blank or "select." Accessibility standards might also guide decision making, for example selecting colors carefully for visual contrast. Whether the display choices and rhetorical decisions were influenced by outside forces, hosting organizations, or technical tools, they all reflected decisions that shaped the users' experience with the dashboard.

The Safe Schools for Alex Florida School Safety Dashboard (FSSD) is hosted by a non-profit born of the Parkland school shooting tragedy of 2018. The FSSD presented publicly available incident and discipline data collected from public schools, including charters, by the Florida Department of Education. The Hawai'i State Department of Education's Longitudinal Education Information System (LEI) also presented incident and discipline data as part of their school report card dashboard, specifically referencing that data are part of the CRDC. Lastly, the Public Affairs Research Council of Alabama Dashboard (PARCA) reported incident and discipline data, but with an explicit focus on racial inequities.

FSSD

The FSSD presented student (mis)behavior as the primary indicator of school safety and sought to leverage the power of comparison and competition among schools to improve school safety in Florida. Like most dashboards we reviewed, the FSSD had limited annotations on the primary displays of data. However, on the dashboard's methodology page, it explained that the Marjory Stoneman Douglas Public Safety Commission "determined that the perpetrator [of the school shooting in 2018] had accumulated 55 disciplinary incidents" while a student, but that the school had "reported zero incidents of bullying, harassment, physical attacks, threats, and intimidation" to the state during those years. It went on to suggest that this was a "failure to report crime...one reason why the school was unprepared for the attack on February 14, 2018."

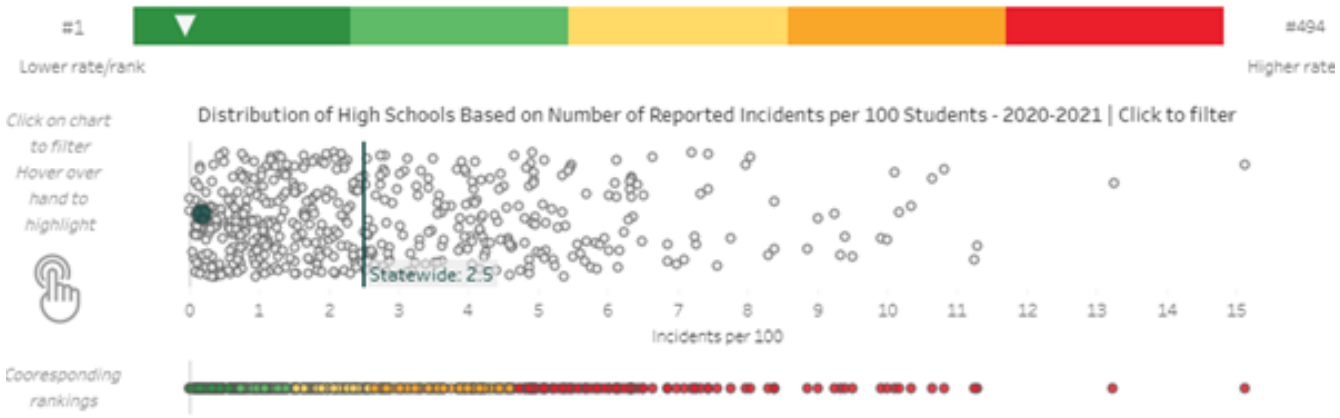
At the data layer of our framework, the site boasted a detailed data set of School Environmental Safety Incident Reports (SESIR) captured by schools and then sent by districts to the Florida Department of Education. No data allowed disaggregation by student sub-populations, or to disentangle student incidents from reported incidents that involved non-students. Referred to on the dashboard as "school incidents" and reported as a rate of incidents per 100 students, it is likely that users view the numbers as a measure of student misconduct. Reinforcing this interpretation, each school's profile paired the school incident data, which was visually prioritized on the page, with suspension information. Users were likely to make this implicit connection between incidents and suspensions, and knowing suspensions only apply to students, this connection reinforced the incident numbers as measures of student misconduct. A trend over time for total incident reports and suspensions was also visualized.

At the visualization layer of our framework, the visualizations on the dashboard focused on comparing schools both through a robust comparison tool for users and by beginning each school profile with a label, ranking it among all schools, and a scatterplot highlighting where it fell in the statewide distribution of incidents per 100 students (see Figure 3). The dashboard employed a stoplight color-coded set of labels, "(red) very high, (bright yellow) high, (pale yellow) middle, (pale green) low, and (bright green) very low," based on the total incidents per 100 students. Applied to schools, this visual metaphor likely resulted in powerful interpretations about which schools are safe and which are dangerous, at which school doors we should "stop" and not proceed and at which we are safe to "go."

In the middle of each school profile was a pair of visualizations offering "incident rank details" organized "into three categories: violent incidents, property incidents, and drug/public order incidents." This was language not used by the FDOE when reporting SESIR data, but instead matched Uniform Crime Report (UCR) categories further framing student misbehaviors as the central factor in assessing a campus's safety. This junior crime statistics treatment echoed the explicit connection made in the methodology between student incidents and crimes, obscuring the fact that many of the incidents were not criminal in nature, e.g., bullying, harassment, and tobacco use. The three large categories were presented in descending order of seriousness and lists of schools in the comparison visualizations defaulted to being sorted in descending order by incident rate. Other default settings, including those in the interactivity layer of our framework, presented the Marjory Stoneman Douglas High School profile as an example report, which certainly brought school shootings to mind for users. Other defaults encouraged users to compare at the school level (rather than county or zip code) and to first examine fighting incidents.

Figure 3

Comparison of all schools – Florida School Safety Dashboard



Note: One use of a stoplight color scheme to rank schools by rates of safety incidents in the Safe Schools for Alex School Safety Dashboard. From www.safeschoolsforalex.org/school-safety-dashboard/.

This presentation did not include any accompanying narrative text (i.e. annotation layer) adding explanation about nuance in the data, for example that different schools likely interpret the definition of fighting differently or highlighting that only 75% of Florida public schools have data included on the dashboard. The FSSD did point out, with regard to suspension data, that "years with <10 reported suspensions are suppressed resulting in no available data; actual values may be higher." If users clicked past the invitation to take a user survey on the splash page, they could see that 891 schools were "non-reporting" and thus not included in the dashboard's collection of 2,649 schools. This significant gap in the sample, however, went unacknowledged in all the rankings and visualizations comparing schools, though it might have provided users a more balanced impression of the limited accuracy of the high/low stoplight labels and rankings lists. In sum, the FSSD data story told users that competitive comparisons between schools on incident data was the key to creating safer schools by increasing the monitoring and modification of student (mis)behavior.

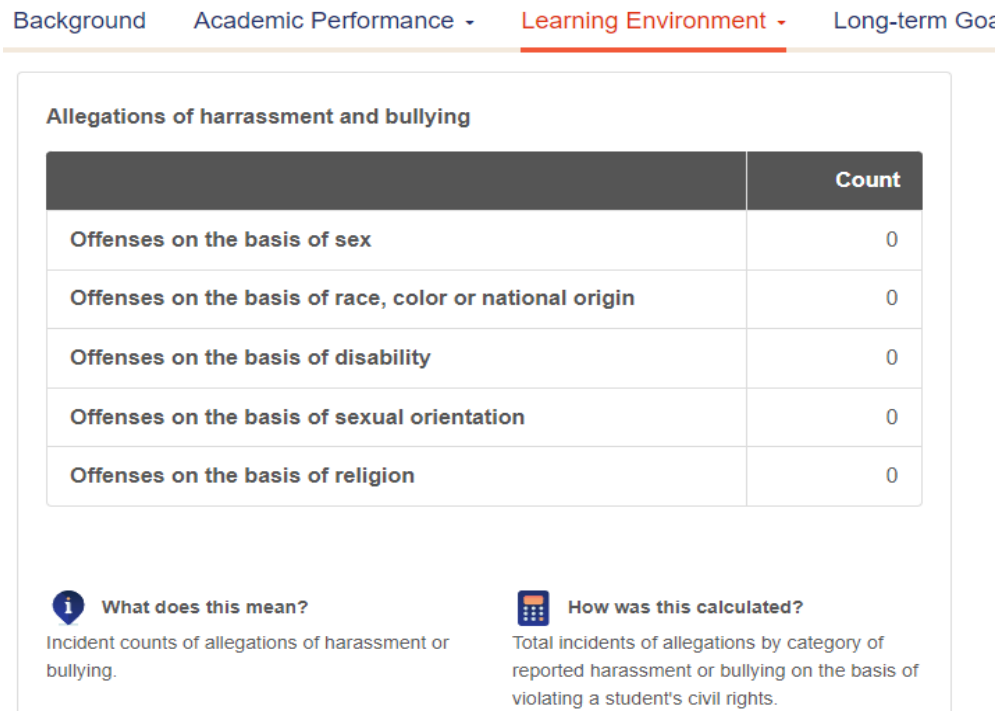
Hawai'i LEI

Hawai'i LEI framed incident and discipline data as concerns about disruption to the school community. The data layer choices, along with some accompanying annotation layer text, demonstrated a focus on inclusion and repairing community. As a category under the "learning environment" tab, along with attendance, staff info, and spending statistics, expulsion and suspension data headlined the discipline page beginning with a short narrative asserting that "the Hawaii Department of Education does not expel students." The text under the expulsion numbers explained that the few students who were temporarily dismissed because of federal laws regarding firearms violations were "provided with alternative educational opportunities and remain active on their respective school's rosters." Given that the "background" tab for each school featured information on community programs available in or near that school, this presentation of expulsion data was in keeping with a similar priority on community.

The behavior incident data included on the LEI and presented under the suspension and expulsion data, related to harassment and bullying. This visualization disaggregated the counts of allegations and student victims to communicate when the bullying or harassment was grounded in prejudice against a group, i.e., on the basis of sex, race, color or national origin, disability, sexual orientation or religion (see Figure 4). Most dashboards that reported incident data disaggregated by subpopulations reported according to the identity of the student reported to have committed the offense. Making different choices at the data layer, Hawai'i instead reported the offense data that might speak to how vulnerable particular groups would feel in the larger school community.

Figure 4

Display of Student Behavior Data – Hawai'iLEI



Note: The Hawai'i Department of Education's Dashboard identifies student behavior and discipline data as descriptive of the "Learning Environment" with an emphasis on what students are harmed by the misbehaviors. From essa.hidoedata.org/schools.

The final set of metrics reported at the bottom of the discipline page involved "violent offenses" disaggregated by type, i.e., rape or attempted rape, robberies, physical attacks, threats of physical attack, possession of firearm. This and all metrics offered on the page had brief descriptions describing "what does this mean" and "how was this calculated." At the interactivity layer, there was no LEI mechanism for comparing schools, though of course users could take the time to look up multiple schools and make their own notes about the data for comparison. The suspension and expulsion numbers did offer a clickable "see more details" that showed statewide totals for comparison. Combined, the rhetorical decisions made by the Hawai'i Department of Education when presenting discipline and incident data told a story of concern for creating community in their schools and a lack of emphasis on competition or comparison across schools.

PARCA

Lastly, PARCA presented discipline and incident data explicitly to describe that "Black students face harsher disciplinary measures than white students" in an effort to influence public policy. The PARCA dashboard differed most significantly from the others in the annotation layer. Specifically, rather than including text to accompany the visualizations, the robust visualizations offered were in support of the text, a policy brief about "School Discipline and Race in Alabama" (Dailey 2020). Detailed presentations allowed users to explore the interactions among offense type, discipline outcome, race (Black, White, and other), and grade level over several years. Surrounding text included statistics that could be discovered through the visualizations, "Looking at dispositions recorded for nearly 60 infractions, in 90% of the infraction types, Black students were more likely to receive an out-of-school suspension than white students for the same infraction." Sometimes the surrounding text offered information not included in the visualizations, but important to interpreting them, e.g., portion of the student population of each race, and variability in how "local schools and systems...interpret [offense] categories." The text also included footnoted background research, information about how other jurisdictions approached school discipline with "more supportive" strategies, and proposed legislation to limit suspensions and expulsions.

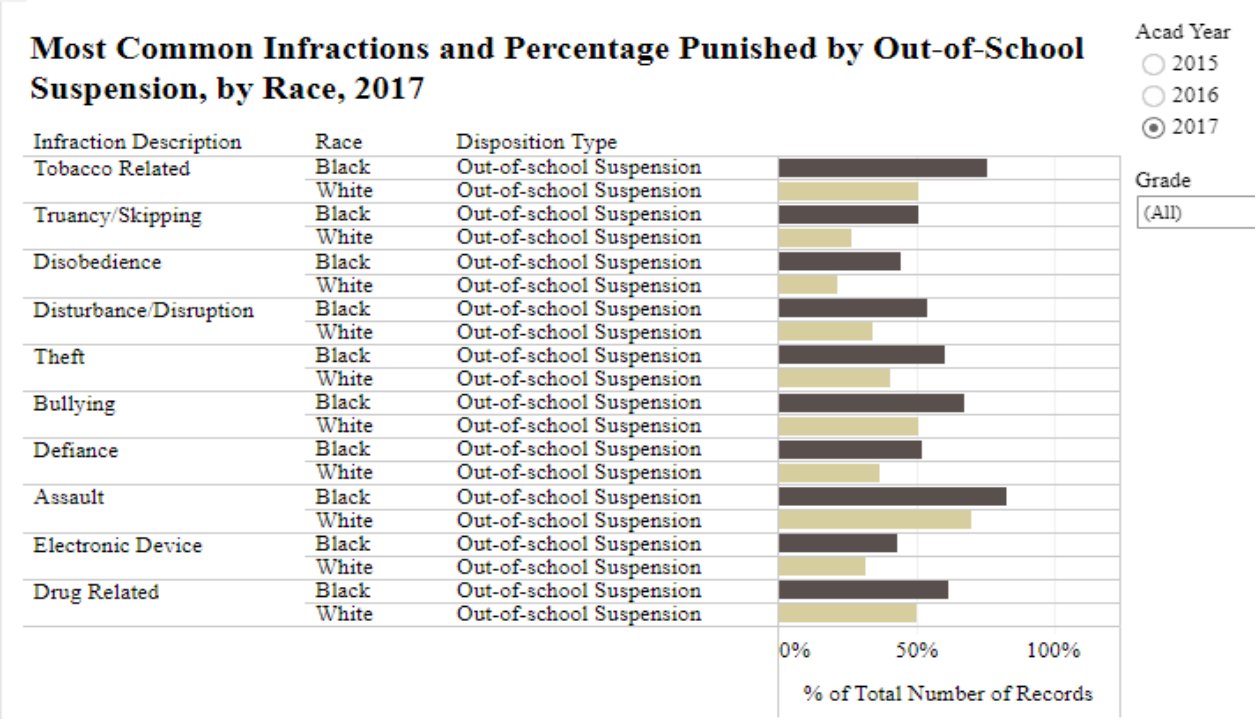
At the visual representation layer, colors on the vibrant visualizations sometimes carried meaning. For example, "Total Reported Infractions by Grade in 2017: All Students" was a bar graph in black/white/grey except for Grades 6 and 9 which were red bars and seemed to highlight significant years for jumps in offense numbers. Charts that directly compared Black and White student populations often used two shades of brown reminiscent of skin colors, again emphasizing the central message of the dashboard (see Figure 5). All data were presented aggregated at the state level, preventing comparisons from district to district or school to school instead keeping the focus on how state policy could address the issue. On PARCA, the data presentations drove the central narrative of the policy brief: there are dangerous discipline practices harming Black students in the state which demand legislative attention.

The contrasting stories about student and discipline data speak to different conceptions about school safety, underlying beliefs, and theories of change. For example, student misbehaviors might signal a step toward criminality that must be taken in hand, a natural and expected by-product of the human development process, or inherent sinfulness to be rooted out of either the individual or the school community. Different philosophies will be made manifest in the way student behavior data are depicted. The example dashboards demonstrated the various design choices exemplified in our theoretical framework and how different dashboards' choices in each layer shaped the messages communicated.

FSSD communicated that students are in danger from each other, in particular from criminal actors among their classmates. One implied remedy was comparing and labeling schools on these student behavior metrics. This speaks to an underlying belief in the value of competition as a reform tool. Hawai'i's LEI suggested that the danger can come from school practices or student behavior that removes students from being in community, suggesting an underlying value of collectivism. Rather than presenting schools as competing, the dashboard aimed to illustrate the shape and state of each campus community. LEI did not explicitly or implicitly pose a remedy, perhaps in keeping with a community orientation that would focus on individual campus communities. This could also speak to Robertson, Nguyen, and Salehi's (2022) findings that de-personalized and standardized electronic data presentations are less relevant communication means for some communities. PARCA communicated that the danger to students comes from problematic discipline practices and that the danger particularly threatens Black students. Policy remedies were proposed for the entire state suggesting a belief in top-down reform.

Figure 5

Illustration from PARCA of a state-wide racially disproportionate approach to discipline



Note: The PARCA dashboard emphasizes disproportionately heavy discipline of Black students, as compared to White students, and aggregates at the state level rather than look at the issue at a school or district level. From parcalabama.org/school-discipline-and-race-in-alabama/

Conclusions

Illuminating the design influences and decisions of school data dashboards offers insights into the undergirding assumptions, values, and beliefs of the organizations collecting the data, the organizations creating the dashboards, and the meaning users might make of the data

presented. Data scientists warn that users often understand data presented visually to be objective (Kennedy et al., 2016) or neutral (D'Ignazio & Bhargava, 2020) when in fact data visualizations, like all text, are cultural products influenced by values and beliefs that tell a story. The four-layer framework we used for analysis helped make visible the diversity of rhetorical decisions made on school safety data-containing state-level dashboards. Further analysis revealed that not only do we not experience the era of big data the same way (Eubanks, 2018), the differences are often by design and reflect assumptions, values, and beliefs that in turn imbue the presentation with a point of view shared with users, whether implicitly or explicitly.

Implications

This review of 115 state-level dashboards containing school safety data points to potential considerations in dashboard design and the need for further research. Dashboard designers and users might employ Hullman and Diakopoulos's (2011) or a similar framework to critically reflect on design decisions and make explicit to users the lens through which they are viewing the data to improve dashboard integrity. Further research on user experiences could reveal how the beliefs, values, and concerns they bring to the dashboard impact their interpretation of the data and how users respond to the concert of rhetorical decisions that shape data presentations into different stories and points of view. Communication styles and preferences are heavily shaped by culture and community (Hofstede, 2011), so it follows that data presentations genuinely designed to inform must take into account audience needs and differences, beyond levels of digital literacy.

This work examines a broad collection of design decisions, but points to some specific design decisions that might be more pointedlyy analyzed. For example, as we found that logos and graphic symbols were commonly used to communicate information, further study could investigate symbols used in connection with school data. Figure 2 shows a judge's gavel representing school discipline, making a connection between student behavior and the criminal justice system without putting it into words. A comprehensive look at the use of symbols on school data dashboards might offer insights into implicit ideas about the work of schools.

LEAs are increasingly creating dashboards, in part as component of a compliance effort designed to make data publicly available. Policy makers drafting these public transparency requirements could offer more guidance and tools to help LEAs create dashboards that meet policy goals, both in letter and spirit. This work could include policy transparency about the goal of the requirements, assistance with ADA compliance, and guidance on gathering user feedback to enhance design. Additionally, offering jurisdictions the technical shell for the creation of a dashboard, a framework that could be edited and adjusted by each LEA, provides an opportunity to offer granular guidance about all layers' rhetorical decision-making.

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Appendix A

(also available at https://epaa.asu.edu/index.php/epaa/article/view/8559/3450)

Coding Form

Coder name

Today's date

Jurisdiction

Hosting organization type:

Department of Education (or equivalent)
Other government agency
Non-governmental agency

Hosting organization name

URL

Dashboard name

What categories of safety data are available? Check all that apply:

bullying/cyberbullying, e.g. bullying offense data, social media monitoring data

cybersecurity, e.g., data security reports, info about stakeholder training

emergency planning, e.g., traffic control data, safety drill data

infectious disease and public health, e.g., COVID, tobacco use/offense data

mental health, e.g., # of students with psychiatric disabilities, suicidality and contact with tipline

targeted violence, e.g., data about violent offenses

school climate, e.g., climate surveys, discipline outcomes data, absenteeism

threat assessment and reporting, e.g., police actions, threat assessments

List the safety related data included in the dashboard (use the language of the dashboard)

Is the dashboard updated?

Yes

No

Can't tell

If yes, how frequently is it updated? [most frequently updated safety related data. Variation in frequency can be noted in the memo at the end of this form.]

NOT updated

More frequently than monthly

Monthly

Quarterly

Biannually

Annually

Less frequently than yearly

Can't tell

List chief colors used on the dashboard's SAFETY DATA presentation (include details about uses of color, e.g., stop-sign colors or greyscaling)

Types of graphs displayed on the dashboard [SAFETY DATA] (check as many as apply)

Bar

Line

Pie

Table

Scatterpot

Map

Pictograph

Venn diagram

Other (describe in note)

Images on the dashboard [as a WHOLE] (check as many as apply)

Photos of students

Other photos

Logos

Other graphics/symbols

Animations

Other (describe in note)

What data is emphasized by visual cues, e.g. color, prominence of placement, font? [WHOLE dashboard, needn't be safety related data.]

safety - discipline and offenses

safety – COVID-19

safety other [add note in memo at the end of this form]

enrollment and/or attendance

student achievement, e.g. test scores, graduation rates

financials, e.g., cost per pupil

other

Is there evidence of data ambiguity regarding any school SAFETY data, e.,g., error measure, confidence interval, narrative note? (you can select more than one)

Yes-on graph

Yes-in narrative

No

Is a default example displayed for users? [WHOLE dashboard]

Yes

No

Is there a suggested search query? [WHOLE dashboard]

Yes

No

Is historical data available? [for any SAFETY data]

Yes

No

Is a historical trend available in one visual display? [for SAFETY data] (as opposed to looking up different data separately)

Yes

No

Can schools be compared in one visual display? [on SAFETY data]

Yes

No

Can districts be compared in one visual display? [on SAFETY data]

Yes

No

Is some SAFETY data disaggregated by subpopulations?

No

Yes by age or grade level (within a school)

Yes by race

Yes by gender

Yes by economic status

Yes by special education status

Yes by English language proficiency status

Yes by other (explain in the memo below)

Titles on SAFETY related graphs (cut and paste)

Explanatory text about the WHOLE dashboard and/or SAFETY data (cut and paste)

{Based on ANY DATA – not just safety related] Does the dashboard assign qualifying labels to schools or districts based on ANY data, e.g. low/medium/high, Pass/Fail, A/B/C/D/F

Can users leave comments that are viewable?

Researcher memo (any impressions or details that might not be otherwise captured above)