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"Is There Anyone in This Room Who Wouldn't Be Counted?" Pedagogy at the Intersection of History, Data Literacy, and Justice

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Abstract: Data literacy explorations are becoming commonplace across a wide range of school subjects. While disciplinary inquiry with data is relatively new to the history classroom, social justice topics are familiar to the setting. Pedagogical practices at the intersection of history, data literacy, and justice have not been studied in depth. This paper identifies pedagogical practices and reflections that shape justice-oriented, high school U.S. history units that center data literacy. Videos of curriculum design meetings, whole-classroom pedagogy, and post hoc reflections on the curricular units were collected and analyzed. Themes from the units, which center the U.S. Census Act of 1790 and W.E.B. Du Bois' transformative work in data visualization, highlight historical inquiry with data and the ways in which data can be used for social change toward justice visions.

Introduction

History education is well underway in its effort to critically consider the role of data science in historical thinking and literacy (Shreiner, 2023). Seeing as the historical inquiry arc strongly resembles inquiry-based approaches within data science (National Council for the Social Studies, 2013; Wild & Pfannkuch, 1999), the integration of the two disciplines within a high school history course may be a generative environment for students to grapple with critical data literacy. In this design-based research project, part of the broader DataX project (Chen et al., 2023), we explore the pedagogical practices of a high school history educator in units that center W.E.B. Du Bois' powerful data visualizations about African American life after the abolition of slavery and scrutinize the evolution of the U.S. census. The units unpack the justice visions of historical figures who used data, ways data visualizations were received, and how data can speak to pivotal social issues. The topics centered in the unit – including how justice visions shape data science work, how data appears in the wild, how data recognizes and obscures particular points of view, and how data science can answer important questions about the impact of government – address critical justice issues in both historical inquiry and modern politics.

Building on commitments in history education that focus on context, motivation, and impact to promote understanding of an event or time period (Maposa & Wassermann, 2009), we fill a gap in the literature by shining light on the nuanced ways a history educator teaches at the intersection of history, data science, and social justice. Through video-based discourse analysis of whole-class pedagogy, unit planning meetings, and post hoc unit reflection meetings, we investigate the following research question: What pedagogical practices and reflections shape justice-oriented, high school U.S. history units that center data literacy? This paper aims to provide concrete documentation of pedagogy in ways that we hope inspire future work exploring the potential of history education to stoke youth-driven reflections on data and justice.

Background and literature

Data is presented to the public across several domains including history, requiring frequent, distinct, and consequential interactions with data in the form of a new civic literacy. This literacy is especially relevant to the modern post-truth era, where data literacy skills can provide an essential tool to challenge and understand the ways in which data-based messaging can be used to influence (Carmi et al., 2020). A common agreement across proposed definitions of data literacy seems to be that data literacy involves using data to support evidence-based thinking, interpreting information, making inferences, and communicating solutions to data problems (Vahey et al., 2012), so it stands to reason that data literacy can be taught across contexts and subjects.

Pedagogical practices that prioritize contextualization of data can be found in history education. Contextualization, which serves to situate evidence or a phenomenon, is seen as a key component of historical reasoning (Van Drie & Van Boxtel, 2008). Infusing data into the teaching of historical contextualization has the potential to build students' data literacy skills. In identifying the creator and intended audience of a source, as well

as the chronological, spatial, and social contexts from which it arose, students are given an opportunity to critically reflect on the purpose behind data investigations and how they impact discourse, decision-making, and policy. Highlighting an author's identities, circumstances, and intentions can serve to uncover the goals of a given data-based claim and raise questions about who that claim is serving. This question of who is being served is crucial when teaching with a justice-oriented framework.

The learning sciences community has been engaged in an extensive inquiry into how to foreground social justice in education, against the backdrop of massively partisan and totalitarian political contexts (e.g., Vakil & McKinney de Royston, 2019). From this body of work, it is evident there is considerable variety in how social justice and equity visions are conceptualized, as well as how they shape pedagogy and curriculum. Inclusive pedagogical practices essential to the teaching of social justice topics include centering the voices of marginalized communities, focusing on critical inquiry, highlighting multiple perspectives, making connections to the present, and fostering empathy and moral and civic engagement (King & Kasun, 2013). These commitments are increasingly present in research on the cross-disciplinarity of data science, which provides important opportunities to investigate contexts through a social justice lens. Researchers in data science education have been calling for a shift towards critical data literacy that utilizes social justice contexts (Louie et al., 2023). Using culturally relevant and humanistic data may make data more meaningful to students as well (Lee et al., 2021; Weiland & Williams, 2023). Some work is underway to create modules and activities that build data literacy through social justice contexts (Vahey et al., 2012). We join these growing efforts to foreground social justice education within data literacy, aiming to contribute concrete examples of data literacy in the context of history education.

The history classroom can provide a valuable place to interrogate, critique, and resist sociopolitical issues like the systemic erasure of particular groups through pedagogical approaches that raise historical consciousness. Historically literate students can gather information from a variety of data sources and consult multiple pieces of evidence to construct a fuller understanding of worldviews in history (Shreiner & Zwart, 2020). The reading and analysis of primary sources of history, or the extraction of meaningful knowledge from data, that occurs through historical inquiry could be more deeply considered through the lens of data science. Indeed, the implementation of data science as a tool for historical inquiries is relatively new to K12 history classrooms (Shreiner, 2023); this might explain why there is a lack of published pedagogy at the intersection of data science education, history education, and social justice education despite the longstanding partnership between pedagogical content in history and social justice framing. While headway has been made to prioritize data literacy and infuse social justice teachings in both data science and history education, there is a need for design-based research documenting what teaching and pedagogy look like at the intersection of the three disciplines. Examples of pedagogy in this space have not been well-documented and it is unclear how instructors have gone about prioritizing critical inquiry of historical contexts with data science.

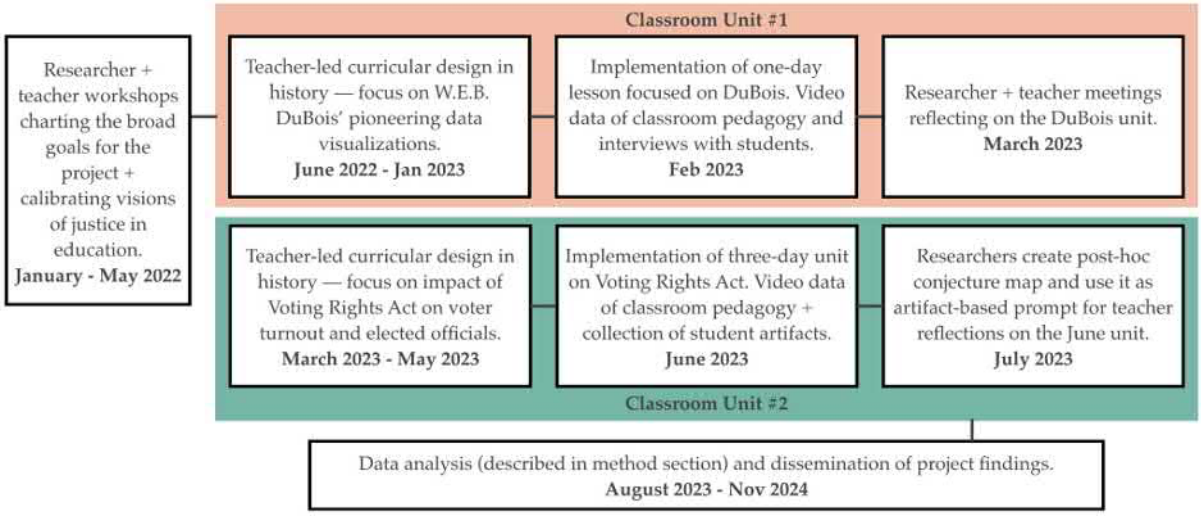
Method

Project context

Across literature that identifies the connection between history, data science, and social justice, a number of data sources have been utilized, such as classroom observations, student artifacts, and interviews (Diederich & Nguyen, 2024). Our work similarly incorporates multiple data sources. The current study analyzes both in-classroom teaching decisions (practices) as well as curricular planning meetings ahead of classroom implementations and post hoc reflections after classroom implementations (reflections).

The goals of the broader DataX project are to create a digital platform and co-develop justice-oriented curriculum that integrates data science into other secondary content areas. For DataX, researchers and secondary level science and social studies teachers used a participatory design approach (DiSalvo et al., 2017) to collaboratively and iteratively design and implement classroom activities and the platform (Chen et al., 2023). Three teachers, 3 researchers, 4 graduate students, and 1 software developer participated in multiple phases of the project (see Figure 1). This paper focuses on one high school history course and a teacher, Mrs. Frank (a pseudonym). The high school chosen for this study is located in a large midwestern city with the following student demographics: 85% qualify for free/reduced-priced meals; 28% English learners; and 53% Asian, 21% Black or African American, 10% Hispanic/Latino; 7% two+ races; 5% White; 3% American Indian (MN Department of Education, 2024). The participating course was CIS American History, an advanced course for grade 11 students. Existing curriculum for the course already centered the investigation of social justice visions through the informal use of data. The social studies teacher, Mrs. Frank, is a White woman who has been teaching history at the secondary level for over 20 years. Our curricular materials revolved around topics Mrs. Frank had already planned to cover at the start of the school year. We share reflections on our positionality relative to this bottom-up approach before the findings section.

Figure 1
Project Timeline



Collaborative process of developing curricular materials

Mrs. Frank and members of the research team co-developed curricular material for 2 units. This process was heavily influenced by tenets of design-based research (DBR) wherein the research takes place in a natural classroom setting and the curriculum is iteratively adapted and improved throughout its implementation (Cobb et al., 2003). Curriculum design for this project was guided by a justice-oriented data science framework that highlighted data practices, disciplinary inquiry with data science, examining justice through data science, critical reflection on data science, and identity and cultural practices (Chen et al., 2023; see also Lee et al., 2021). Two units were designed to integrate these areas within a historical context. After unit development, classroom integrations were then conducted to see the technology and pedagogy in action and video of whole classroom pedagogy was collected. The first unit focused on the U.S. Census data and the data visualization work of W.E.B. Du Bois. The second unit focused on the 1965 Voting Rights Act. In each unit, the teacher-led discussions about the focal historical time period focused on the historical figures in those moments, reflected on what data they collected and how it was presented and received at the time, and then asked students to use the project's data science software to work with data from this time period, creating visualizations, reasoning about those visualizations, and sharing arguments in writing/presentations and with the whole class.

Data

This study includes video recordings of Mrs. Frank's whole-class pedagogy in two history classes as well as pre- and post-implementation reflection conversations. The bulk of our analysis relies on the video recordings from the classroom. We did not receive consent from all students, so the camera was strategically aimed at the front of the classroom to only record the teacher and any material they presented; data analysis of classroom video was limited to the instructor's pedagogical moves. As a feature of this paper's focus on documenting pedagogical practices, students' contributions, learning trajectories, and outcomes were not taken into consideration. Soon after each unit, the teacher met with members of the research team to reflect on the curriculum and students' experiences. In an additional reflection interview, the research team and teacher gauged the quality of the unit, prompted by our post hoc conjecture maps (details below).

Analytical approach

Our analytical approach aims to document central themes that undergirded both the classroom pedagogy and our team's reflections on the unit. The above-described justice-oriented data science framework was developed in an earlier stage of the DataX project to drive curricular design (Chen et al., 2023). The research-based framework guided our design-based research effort to retrospectively analyze (see Cobb et al., 2003) the implemented units. We anchored our retrospective analyses in the template of conjecture maps that the research team created following the completion of the second unit, noting key design elements, expected short-term processes, and valued longer-term outcomes. These conjecture maps attended to the facets of our justice-oriented data science framework, captured our impressions of what worked well, what was emerging, and what did not work well in each unit, and were then used as artifacts/boundary objects to develop interview questions for the teacher's final

reflection. Conjectures were then formalized and a member of the research team used them to inform a thematic/content analysis (Krippendorff, 2018) of the post-implementation teacher interviews to draw out common themes around what worked well and what was difficult.

The next stage of our deductive thematic analysis began with these formalized conjectures and themes. We first revised them to focus on teacher pedagogy rather than student outcomes (in alignment with our RQ) and included examples of pedagogical moves. This iteration of revised themes was then used to analyze the classroom videos. During this analysis, themes were refined to include subthemes that further clarified the ways each might stand alone or interact. This step is the analytical backbone of our findings below. Though our analysis did not focus on teacher-student interactions, we adhered to tenets of interaction analysis (Jordan & Henderson, 1995), in that we refrained from speculating on the teacher's intentions and instead examined the design of her language and multimodal features including gesture, body movement, and surrounding artifacts on the board. Subthemes detailed the pedagogy of specific practices such as summarizing a key idea of a data visualization and how specific features of the visualization amount to a main idea. Special attention was paid to the two themes that describe the way disciplinary context and data practices are woven together and how this relates to the identification and critique of justice visions. Finally, we explored how these themes from the classroom pedagogy triangulated to the curricular planning sessions and debrief sessions. We found that all the themes were covered in these three discourse spaces. In our findings section below, we pull orthographic transcripts of talk (from the teacher and researchers) that arose during the classroom pedagogy, curriculum design meetings, and post-implementation reflections to provide the reader with the most direct, multi-vocal impression of participants' voices during our design-based research process (Tracy, 2010).

Positionality statement

As a team, we reflected often throughout this project on the contrasts between our own identities (members of our team identity as White, Chinese, male, female, residents of U.S. states in the Midwest, residents of a large city, practitioners of data science, high school teachers, educational researchers) and our experiences in the present-day world relative to the individuals whose stories we explored in the unit, including voters disenfranchised in southern states in the U.S., African Americans forced into slavery, justices who passed the Voting Rights Act, W.E.B. Du Bois and his research team, and various politicians. In response, our commitment as teachers and scholars – in particular in the context of history education – was to honor the voices of people whose stories we explored, bringing into the classroom primary sources that contributed their perspectives, in particular their justice visions around inequality, race, and power in their time, making space for students to decide how they resonated with these ideas. We are deeply aware that research and practice teams would intersect with these historical figures in different ways and in ways that might explore new intersections of justice, data, and history. Our effort here is intended not to represent the way to explore this intersection, but to see some concrete ways that justice, data, and history intersect with pedagogy in ways that we hope provide resources to others designing at this intersection and exploring justice angles vital to their visions of equity.

Findings

This paper presents one of three vignettes that illustrate the resulting themes across multiple parts of the history curriculum and showcase triangulation across the data sources. This vignette is grounded in a topic (Du Bois' data visualizations) that stretched across both units. Quotes from the curriculum design meeting recordings and the post-lesson debriefs are woven in to note points of triangulation and nuance the themes. We hope these examples will spur complex questions about pedagogy and curriculum design for justice-oriented data literacy within a history classroom. While not all subthemes will be discussed in the selected vignette, Table 1 presents parent themes and subthemes identified across all vignettes.

In this vignette, Mrs. Frank shared a perspective on the historical context around Du Bois' data visualizations. Her teaching wove together history and data literacy in its focus on understanding Du Bois himself, what his team wanted to accomplish with their data visualizations, and how they pursued their data collection and presentation work. In her pedagogy, Mrs. Frank stitched together components of each theme by unpacking the justice visions of specific data visualizations, referencing not only data practices, but also the historical context of Du Bois' life. By drawing students into this historical moment – filling in the picture of Du Bois' life and his central beliefs and goals – data literacy became something considerably more than understanding trends in history. It became focused on understanding how people told stories about their lives through data at that time, what justice ends they were pursuing, how people at the time may have reacted, and what this meant about the power and limitations of data for justice.

Table 1
A Table of Themes Identified with Subthemes

Theme	Subtheme
Theme 1: Engaging with specific data practices.	A. Students can be guided to explicitly notice and understand features of data visualizations and data/data collection. B. Students can be guided to summarize the key idea represented by the data visualization. C. Students can be guided to identify how data visualization features and data collection practices amount to a purpose/main idea. D. Students can be guided to notice and reflect on information missing in the data visualization or lack of clarity in the presentation of data. E. Students can be guided to wonder and reflect on anything that was missing in the underlying dataset that creators used in the focal data visualization. F. Students can be guided to identify patterns in data, including what might constitute correlation versus causality. G. Students can be guided to explore the aesthetic qualities of data visualizations.
Theme 2: Engagement with data practices that are contextualized in historical understandings.	A. Understanding the meaning of variables, and why particular variables were collected or not, in data visualizations through historical contextualization. B. Understanding the meaning of patterns or relationships between variables in data visualizations through historical contextualization. C. Forecasting the meaning of patterns *beyond* the focal data visualization through historical contextualization. D. Inquiring into how people at a particular time point in history reflected on or took action in response to seeing the data visualization.
Theme 3: Inquiries into "messier" or "more real" or "deeply flawed" datasets.	A. Highlighting the epistemic nature of data science; meta statements about the inherent messiness of data science. B. Acknowledging that data itself is messy and attributing messiness to specific factors. C. Thinking critically about how the inherent messiness of data limits the scope of support/conclusions for key ideas in a data visualization. D. Marking that the dataset or data visualization is an "in the wild" example.
Theme 4: Encouraging students to bring personal and community topics into discussions about data.	A. Instructor prompts students to orient to their own world/life/community/ personal identity.
Theme 5: Pointing to ways data work could be used for social change towards certain justice visions.	A. Looking for justice visions across data visualizations that are distinctly different, even clashing, at very different points in history. B. Unpacking the justice vision of the people who created the data visualization. C. Examining *how* the creators of the data visualization executed their justice visions (which might not be readily transparent). D. Inquiring into how people at a particular time point in history took action (or not) *toward social change* in response to seeing the data visualization (related to 2d).

Critical reflection on the U.S. Census

The first unit began with a discussion of the U.S. Census and its iterations, with particular focus on what information a government might find useful to collect and what information citizens would realistically provide. The class homed in on demographic data and defined very specific and personal variables, to which Mrs. Frank countered, "You'd be cool with the government asking you those questions?" as well as asking students what information they would keep from the government. Answers to these questions relied on students' reflections on their own experiences with and opinions of the government (Theme 4a). Moving beyond defining variables of

interest and onto data collection and reporting, Mrs. Frank then presented the first oath taken by U.S. Marshals and their assistants per the Census Act of 1790, and prompted, "does it allow for mistakes?" The class dissected the oath and Mrs. Frank shared the conclusion that "human beings do tend… human beings make mistakes periodically." In these turns, Mrs. Frank outwardly drew attention to the fallibility of people in the data collection process as a specific factor for why data might be messy or flawed (Theme 3b). Following this line of thought, Mrs. Frank presented the reality of missing information from the U.S. Census given what the class already knew about the population at that time (Theme 2a). Prompting students to attend to their personal identities to illustrate the erasure they might have faced in that historical period (Theme 4a), Mrs. Frank asked, "Is there anyone in this room that wouldn't be counted?" while projecting the census questions to the class. With these questions, Mrs. Frank started to assemble a picture of data science as a process that can erase and obscure, and which raises questions about trust and completeness, setting the stage for the politically potent work Du Bois and his team took on at the end of the 19th century.

Situating the work in Du Bois' life

Mrs. Frank continued by providing a sense of what W.E.B. Du Bois and his team were facing, including erasure of voices from the national census, as an impetus for why Du Bois went to considerable effort to collect new data for a series of visualizations his team would present at the Paris Exposition Universelle in 1900. These data visualizations, focused on data about African American life in the south following the abolition of slavery, covered education trajectories, property ownership, employment patterns, and other features of everyday life in evocative designs that often wove in historical detail to contextualize the magnitude of systemic burdens, violence, and inequities facing African Americans in the United States.

Mrs. Frank layered in biographical context surrounding Du Bois himself, and what might have made his perspective unique relative to African American life in the south (Theme 5b): "He was from a very wealthy family, he lived primarily in the north. None of his immediate relatives had been enslaved in their lifetime, so in some ways he would've had a very different perspective I think from people at the time." Providing not only historical context, but specific biographical details about Du Bois, Mrs. Frank signaled to students the reality that data visualizations are less so neutral representations out in the world than portraits of a slice of the world that come from particular life experience and viewpoints.

This discussion had the downstream implication of providing students with an opportunity to speculate on Du Bois' intention(s) with data visualizations. Mrs. Frank nudged the students to consider Du Bois' intention behind particular data visualizations he and his team had created (Theme 1c): "does somebody think there's a hidden message?" More specifically, Mrs. Frank was not asking for a message solely gleaned from the visualizations themselves, but also from an understanding of who Du Bois was and what he was pursuing: "So what is the message he's trying to tell us?" This discussion became a material, historically situated, primary-source exploration of how purpose can be tethered to the designer of the visualization.

After the unit, our team reflected on how we could have done more to highlight the unique/additional data Du Bois collected. During a post-lesson reflection, David (Author 2) noted: "[Du Bois' team] went to a lot of trouble to collect new data…and that just never…we were hoping that students would see it bottom up but there was so much happening…there's clearly more to consider there." In addition, Mrs. Frank reflected on how she might have gone further to flesh out the context of the Paris Exposition in 1900: "I'm not sure I did a good job of introducing the exhibit. I feel like I could do better." These comments critical of where we might take the curriculum in a subsequent effort reflected a constant concern of our design work. In this unit, students' reflections on data visualizations were situated in more than the features of the visualization themselves; they were situated in points in time – historical figures (Du Bois) and historical contexts (a global exposition) – that needed to be understood to grapple with how data about the abolition of slavery and events during the reformation period were corralled, represented, and understood in their time. These reflections represented a broad pedagogical challenge in history around how we invite students into a historical moment deeply enough to give them traction to critically evaluate the impact of how data was seen and presented in its time.

How visitors might have experienced Du Bois' data visualizations

As the lesson continued, Mrs. Frank extrapolated on the design of Du Bois' data visualizations at the Paris Expo, and how that design might have shaped viewers' sensemaking about the visualizations. This meant providing a way to picture the layout of the data visualizations at the exposition, analogizing to students' experiences, and showing photos of the visualizations and organization of the exhibit (Theme 5d): "This exhibit was meant to be entered from a specific side and gone through a specific way and the very first, very very first thing that would have been on there would have been this image [map of slave trade] that shows the African diaspora out of Africa right and where they went into the Atlantic [world?] and he starts with this, right? Then takes us through time,

right all the way to 1900." When revisiting the exhibit in the next class, Mrs. Frank invited students into the design of the space, and extended this discussion to start to explore Du Bois and his team's intentions:

> This is the first image that everybody saw, and the reason that Du Bois does this is because he wants the mindset of all the visitors to the exhibit to be in what is the origin story ... for African Americans and at this time in the 1900s the origin story is predominantly this [gesture to data viz on board] right? the slave trade, he's rooting the whole story in the same history...they all started as enslaved people in the U.S. … the whole point was to root you in this 'here are the disadvantages, here are the challenges that people are facing" and then "this is what they were able to accomplish' … so he was moving from this horrific origin point – and then showing the difficulties – but yet… despite… we see… right? We can all think of the Maya Angelou poem, 'And still I rise'

In this extended comment, Mrs. Frank surfaces for students a central political, justice-oriented commitment of Du Bois and his team. Described by Battle-Baptiste and Rusert (2018), in their historical reflection on Du Bois' visualizations, this was a way to recognize the "gains that had been made by African Americans in spite of the machinery of white supremacist culture, policy, and law that surrounded them…challeng[ing] the dominant frameworks of liberal freedom and progress that characterized" (p. 19) other exhibits at the time. Through a reflection on the design of the layout of the visualizations at the exposition, Mrs. Frank opened up for the students an insight into what political position Du Bois and his team had intended to convey through their data work. At the same time, after the unit, our group reflected on the limitations of our approach. Recollecting discussions with students during the class, David noted that students "wanted more information about how visitors reacted to Du Bois' exhibit, and we had nothing on that," boiling this notion down to the question of 'How should I think about how this was interpreted by people at the time?'

Mrs. Frank then shifted the focus to what the class could learn from the patterns seen in Du Bois' visualizations. Mrs. Frank first established common ground around the data visualizations. This meant noting clear-cut data practices, like noting the Y axis on a property and value visualization (Theme 1a). Similarly, Mrs. Frank accented the historical context surrounding the data Du Bois presented. Focusing on a property value visualization, she noted that "he's giving us…he's layering in the context of the time to help us better understand the obstacles people were facing and their ability to…prosper anyway…" In this way, Mrs. Frank described a purpose of the visualization along with how this purpose was made clear by Du Bois' choices (Theme 5c).

This recognition of the ways Du Bois infused his visualizations with the circumstances of the time captured the class's work from the first lesson where students leveraged their own contextual explanations of trends in the data. This meant exploring data trends in Du Bois' visualizations, and crucially, why they might have occurred (Theme 2b). In response to data showing that education enrollment was rising, Mrs. Frank asked, "Why might that be?" and built on a student's idea that this could be credited to the "Freedmen's Bureau." Mrs. Frank offered this question about a series of patterns, only needing to say, "Any hypothesis?" and students started to offer explanations for trends in the data. In some instances, Mrs. Frank followed up with her own hypotheses, specifically around declining White enrollment and rising African American enrollment in schools and explained, "most schools during reconstruction were still segregated with the exception of the schools in New Orleans, but it could also be that some of these people were fighting between 1861 and 1865" (Theme 2b). Mrs. Frank often shared her own epistemic humility around students' proposed hypotheses and continued layering in her own interpretations of historical context behind patterns in the data.

Discussion and implications

The themes shared in this paper showcase the ways in which data literacy, history, and social justice can be woven together within pedagogy. The themes highlight data practices with real data, contextualizing data practices within history, and using students' lived experiences as a point of departure to identify and critique the justice visions of those who report on and present data. These themes anchored the instruction across the larger project and within the multiple vignettes. The highlighted vignette illustrated at least one subtheme from each broader parent theme in Table 1. The data sources for this curricular unit showcased pedagogical practices that highlighted data practices as well as disciplinary engagement around data through the contextualization of these practices in historical understandings. Students were guided to notice explicit features of data visualizations and the underlying data as well as how these features added up to a focal message. While full context may not be necessary to complete all data practices, contextualization is a key component of historical reasoning and a large part of what makes data science unique in this discipline. The second theme illustrates these data practices being contextualized in historical understandings with questions about why certain variables were collected and looking beyond the data

visualization in question to interpret the larger context not shown. Students were provided with real data and discussed who collected the data, why particular variables were collected or not, and what conclusions could be drawn. Beginning with the U.S. Census, Mrs. Frank scaffolded students to notice the demographic information collected and how variables were created from this information. The class discussed the lack of representation for vulnerable groups and how the reporters of this data might have benefited from this erasure. This discussion ultimately turned to the ways in which this might have influenced how W.E.B. Du Bois and his team collected data and presented it. The pedagogy highlighted in this vignette prepared students to think carefully about the choices they make when presenting data, a later part of the curriculum highlighted in another vignette not included in this paper.

These pedagogical moves were often prefaced with conversations around students' experiences and resulting opinions, which provided perspective and allowed students to relate to the material. Asking questions about their own representation and if they would lie to the government provided them with the opportunity to reflect on their identities and feelings surrounding data collection from persons or institutions of authority. Students were guided to grapple with the ways in which people were systematically oppressed based on their own backgrounds and identities. The data practices, historical inquiry, and critical reflection on data and self made it possible to examine justice and the ways data work could be used for social change. Each theme ultimately pushed toward this larger goal of identifying justice visions throughout a historical time period through the examination of the data practices employed at that time. Students cannot attend to how a data visualization creator conveyed their message and investigate the possibly veiled justice vision without understanding features of data visualizations in context. Further, in order to push students to inspect an observer's reaction to a data visualization, such as those who visited the Paris Expo, Mrs. Frank evoked students' own experiences with the presentation of information such as college fairs. Moving beyond contextualized data practices towards the identification and critique of justice visions requires instructors to continuously address the broader social perspectives that students bring into the classroom because "contextualization and awareness of presentism are not enough. If racialized experiences," or experiences with other oppressive systems, "are tangled in with contextualization and presentism, then any curricular changes should address all three" (Santiago & Dozono, 2024, p. 34). Santiago & Dozono (2024) suggest that beyond basic content knowledge, history education should foster student awareness of how their experiences with systems of power and oppression inform their interpretations of history. In line with contributions from learning scientists, this argument against neutrality acknowledges the politics of learning (McKinney De Royston & Sengupta-Irving, 2019). It is only by embracing non-neutrality that the intersection of history, data science, and social justice can be adequately explored. While not a direct mapping onto the key areas presented in our justice-oriented data science framework, there is clear overlap with the framework that guided curriculum development. A longer version of this manuscript includes analysis of two additional vignettes.

The pedagogical practices highlighted in this paper provide educators and researchers with concrete examples of how a teacher might guide students to identify and critique justice visions present throughout the data cycle with the aid of their historical and cultural understandings. This value was affirmed in the *Journal of the Learning Sciences*' special issue on data science education, in which the editors emphasize the goal of developing "students' identities as agentive data practitioners who recognize the historical and political dimensions of data as social texts" (Wilkerson & Polman, 2020, p. 4). The integration of history education, data literacy, and social justice teachings through the pedagogy identified in this paper may help address critical justice issues in historical inquiry and how data can speak to pivotal social issues around systemic, racial inequities.

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