Inspiring and Supporting the Next Generation of "Data People" through Data Storytelling

Joseph Polman

April 1, 2025

School of Education
UNIVERSITY OF COLORADO **BOULDER**

Plan for this talk

- How could data storytelling lead to “data people”?
  - Identity development and learning
  - Data in contemporary life
- Data-Infused Interdisciplinary Project-Based Learning (DIPBL)
  - Data journalism (STEM Literacy through Infographics)
  - DataPBL
- Coda

How could data storytelling lead to “data people”?

- Purposes of schooling and other organized educational efforts
- Learning and development
- So what?
  - Civic engagement
  - Everyday life

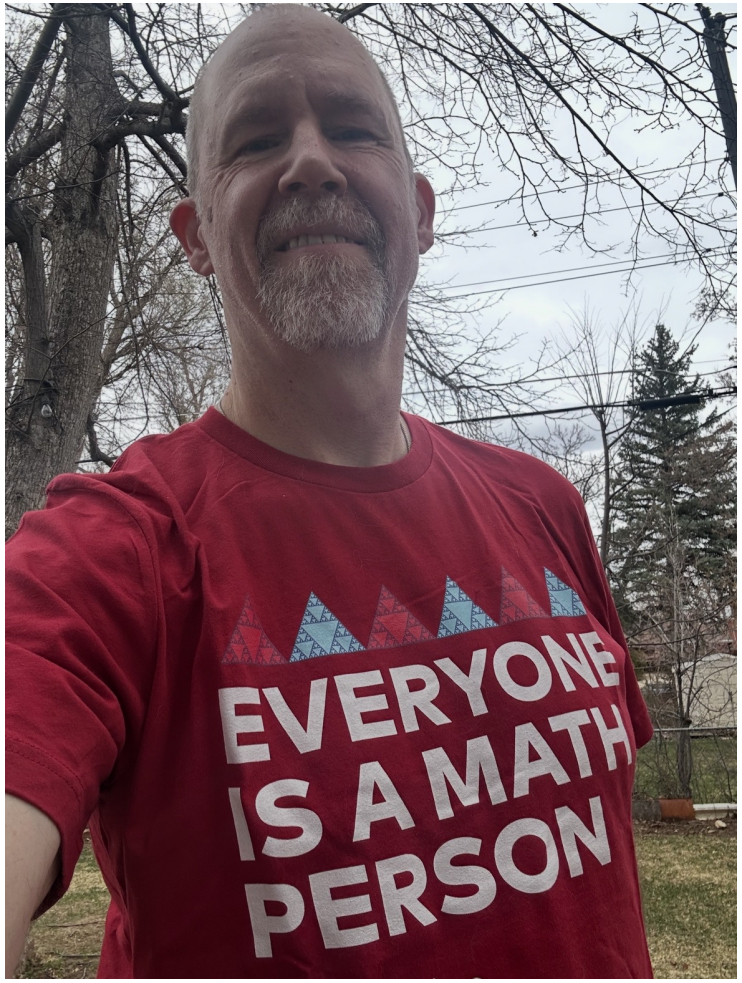
Learning and becoming in practice …

"Coming to be, know, and do"

Herrenkohl & Mertl (2010)

“I am a ____ person”

- Growing body of research on disciplinary identification & learning
  - ”I am a math person”
  - “I am a science person”
- Why not a “data person”?
  - Increasing prevalence of data and data science
  - Increasing importance to
    - Political and community decisions/actions
    - Everyday life
  - Fighting misinformation/disinformation



What would a data person be like, and do?

- See data as relevant to their lives
- Have agency with using data
- Have competence at using data fluently and judiciously at informing epistemic understandings of difficult issues

How did I get here?

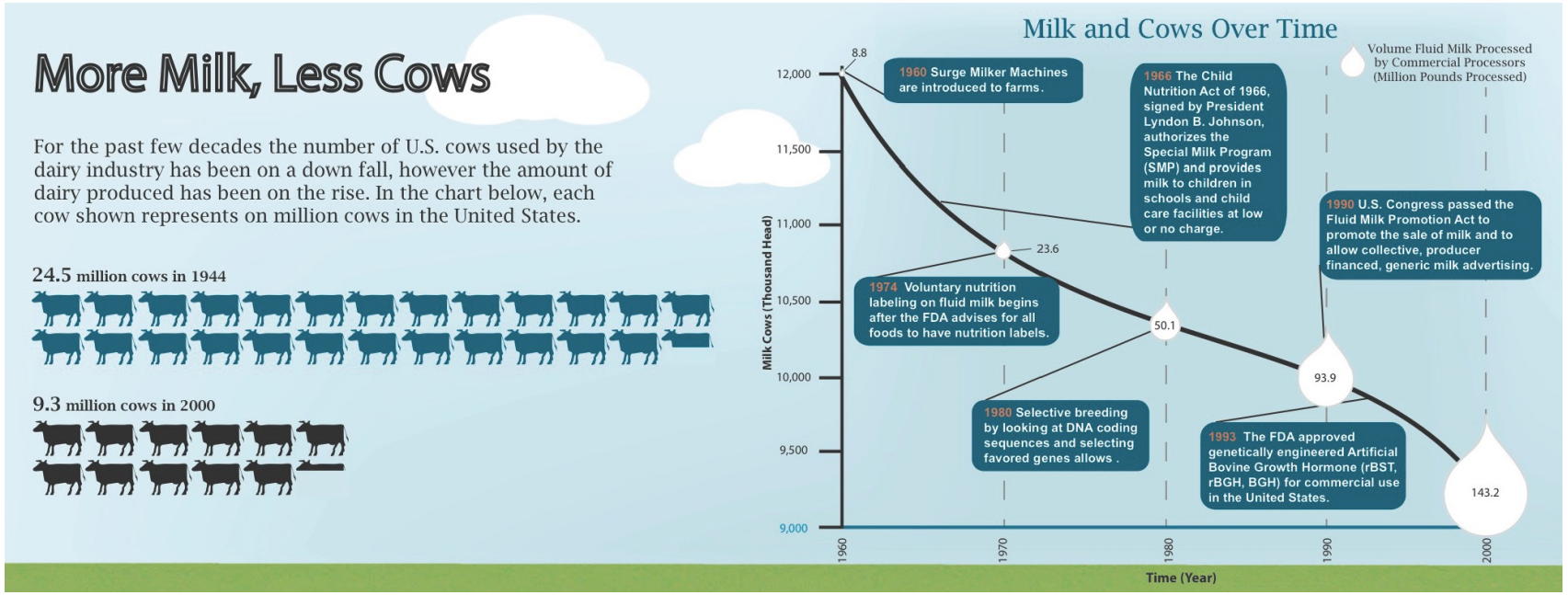
My background in DataViz and Data Storytelling embedded in project-based learning

- Learning through Collaborative Visualization (CoVis) – science projects – (1990s)
- Infographics-based data journalism for STEM and data literacy (SLI; 2011-19) *
- Air quality and soil quality inquiry in rural Colorado schools (2018-present)
- Contextualizing Data Education via Project-Based Learning (DataPBL; 2022-present)

PBL for STEM Literacy

STEM Literacy through Infographics

STEM Literacy = using science in everyday life



Collaborators on this project: Engida Gebre, Andee Rubin, Cynthia Graville, Alan Newman, Joanna Weidler-Lewis, Stephen Sommer, Chelsey Shade, Rob Lamb, Rosemary Davidson, and many teachers

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Contextualizing science in life

Gebre, E. H., & Polman, J. L. (2020). From "context" to "active contextualization": Fostering learner agency in contextualizing learning through science news reporting. *Learning, Culture and Social Interaction, 24*, 1-15.

Lara & Chelsie

Climate Change ≠ Hurricanes...?

Are Hurricanes Affected by Climate Change?

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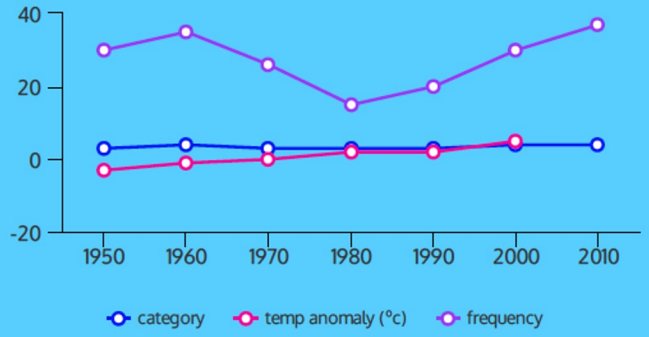
Lara

Are Hurricanes Affected by Climate Change?

Hurricane Conditions



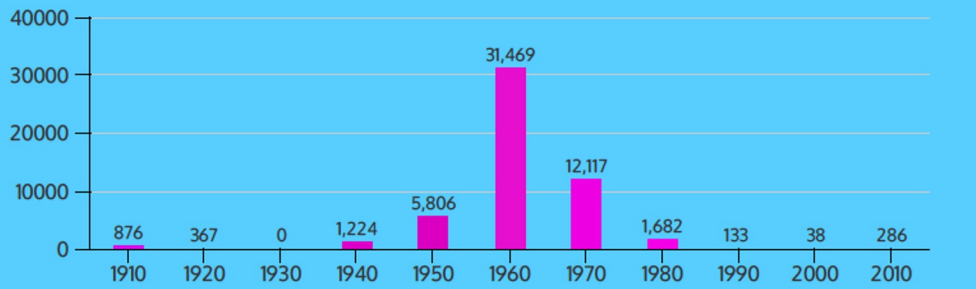
A **category** is a 1-5 scale based on the hurricanes sustained wind speed.

A **temperature anomaly** is a shift in the long term temperature average. A positive anomaly shows that the observed temperature is warmer than the reference value.

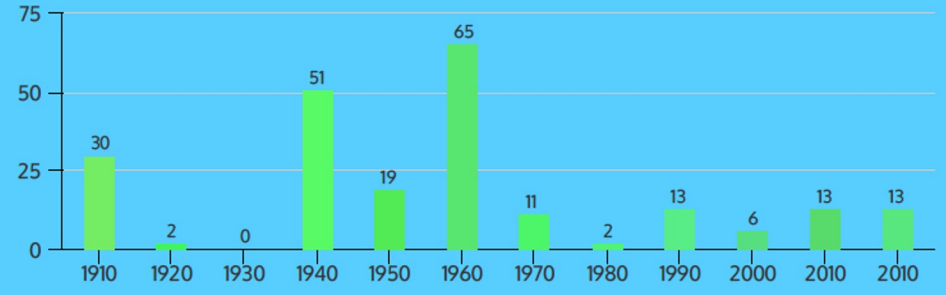
The **frequency** of hurricanes per year.

The scientific community has been in a disagreement over this subject, arguing whether or not global warming has something to do with the frequency or intensity of hurricanes. On one side people are saying that global warming has created an ideal environment for hurricanes to form while others are saying that although we are on an upward trend, there is no evidence linking global warming to hurricanes.

Affects on People



Damage in millions of dollars



Hurricane Related Deaths

Sources: University Corporation for Atmospheric Research, National Oceanic a
Administration, NASA, National Hurricane Center, and The World Climate Repor

Lara

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Chelsie

Climate Change ≠ Hurricanes...?

Scientists are investigating whether or not climate change has any correlations to hurricane patterns in the North Atlantic.

Temperature Changes

From 1901-2014, the SST (sea surface temperature) of the Atlantic Ocean has increased by about

+1.26°F

Data represented from EPA

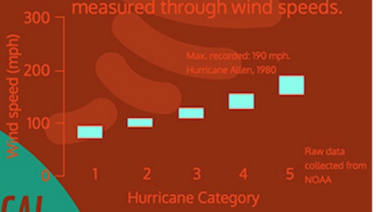
With increasing SST, it's predicted that the heat will be able to nurture storms. While there is observational data on weather patterns, we lack observational data on climate change.

Types of Storms

Tropical storms, cyclones, tropical cyclones, hurricanes, typhoons--all of these are interchangeable names that all refer to the same disaster type.

Intensity

The intensity (category) of hurricanes is measured through wind speeds.

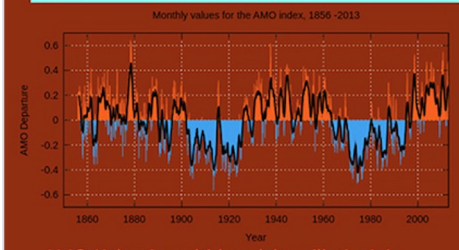


INSUFFICIENT HISTORICAL RECORDS...?

While the theory still stands, there is questioning behind the historical records. In the 20th century, all collected hurricane data was faulty and merely estimated.

NASA argues that there isn't enough observational data to map out any trends.

AMO

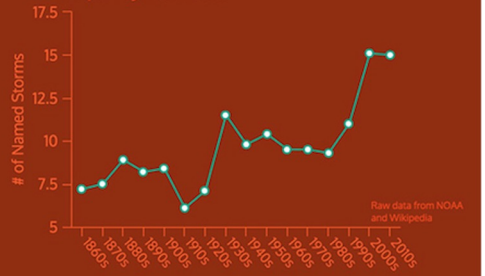


AMO (Atlantic multidecadal oscillation), is the theory of a current that causes SST in the N. Atlantic to fluctuate; it suggests that the N. Atlantic basin goes through series of active and inactive "cycles".

It's possible that the recent uprise in TCs could be due to an active cycle. However, there isn't enough data over time to fully map out any trends.

Frequency over time

The graph below shows the average amount of named storms per decade from 1860-2010s. There are similarities when compared to the AMO graph, but overall, hurricane frequency has risen.



It is possible that climate change may affect frequency, but it's uncertain.

Although it's possible that climate change may have something to do with hurricane frequency or intensity, we lack observational data to truly prove anything.

*Temperature Changes data: https://www3.epa.gov/climatechange/science/indicators/oceans/sea-surface-temp.html
Intensity data: http://www.nhc.noaa.gov/aboutsshws.php
AMO graph: https://en.wikipedia.org/wiki/Atlantic_multidecadal_oscillation
Frequency data: http://www.aoml.noaa.gov/hrd/tcfaq/E11.html
Frequency data: https://en.wikipedia.org/wiki/2015_Atlantic_hurricane_season

Chelsie

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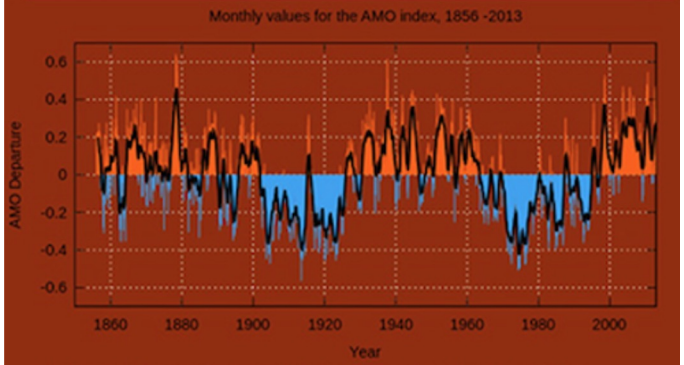
Epistemic Progress

AMO



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INSUFFICIENT HISTORICAL RECORDS...?

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Identifications and desire for practical action

- Sense of dismay
- Mismatch with their desired identifications
  ≠“climate change denier”
- How to interact with a community member who wants her to espouse the activist stance

Gains on Survey & Questionnaire

- N = 272 students (who participated in the research)
- 12 teachers at 7 schools, 2016-17 schoolyear

	Pre-Test Score Scale 1-5 Mean (SD)	Post-Test Score Scale 1-5 Mean (SD)
How interested are you in learning science in school? **	3.41 (1.29)	3.61 (1.16)
How interested are you in learning science outside of school? **	2.85 (1.22)	3.12 (1.09)
Other people see me as "a science person" **	2.64 (1.28)	2.85 (1.25)
Mathematical reasoning ** (scale 0-6, Qs about census data table)	3.94 (0.08)	4.22 (0.08)

** $p<0.01$, paired samples T test

DataPBL: Data Literacy & Data Identity

Contextualizing Data Education via Project-Based Learning

Data Literacy = using data in everyday life

Data Identity = seeing oneself as a “data person”

Collaborators on this project: Trang Tran (now at U of Alaska Anchorage), teachers at two schools

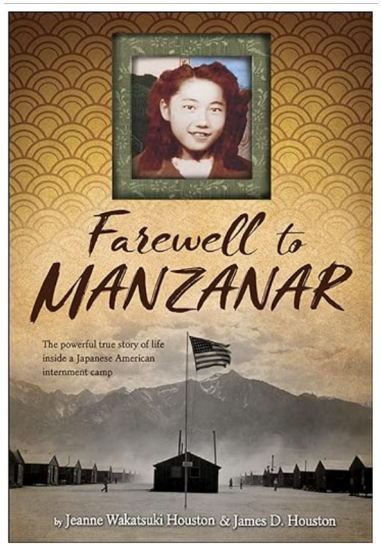
The Concord Consortium

Kate Miller, Chad Dorsey, Steve Roderick, Cynthia McIntyre

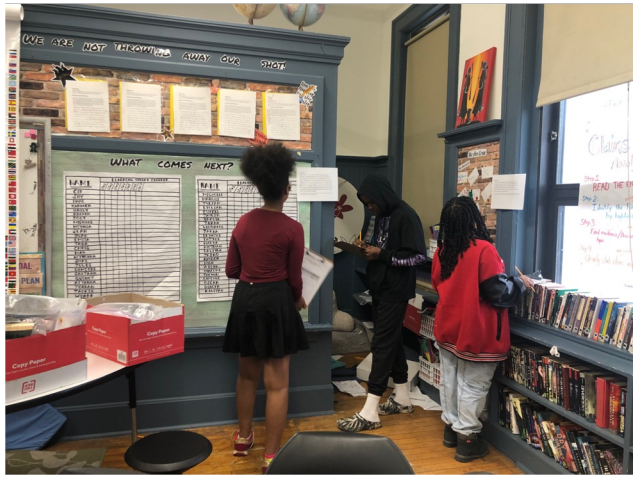
Education

Linda Grein, Jordan Templeton, Ron Berger

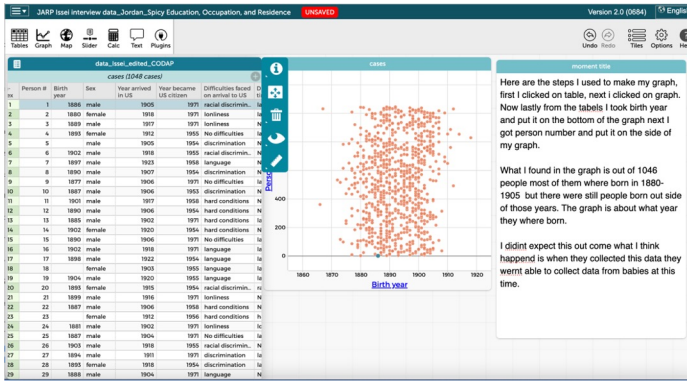
The stories of Japanese American internees before, during, and after incarceration



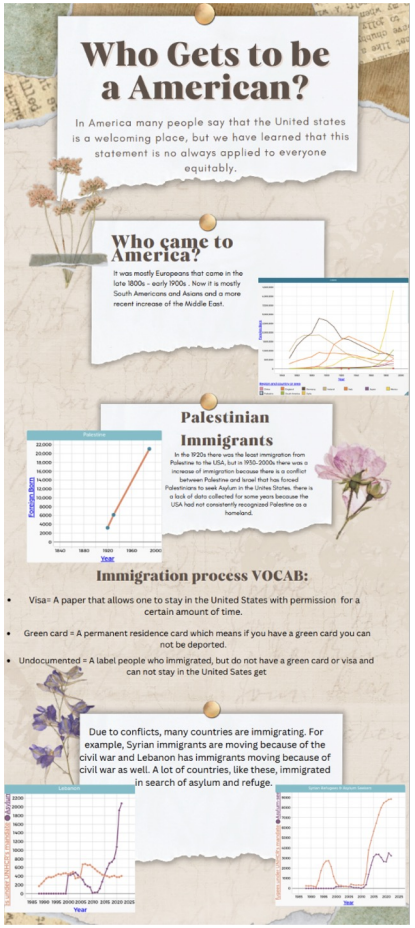
- Read *Farewell to Manzanar* memoir (Wakatsuki Houston & Houston,1973)
- Gallery walks
- Learned how to work with JAI-focused data on CODAP (http://codap.concord.org/)
  - CODAP Story Builder
  - Peer feedback
  - Data story presentations



What Students Did



CODAP data story



Infographic

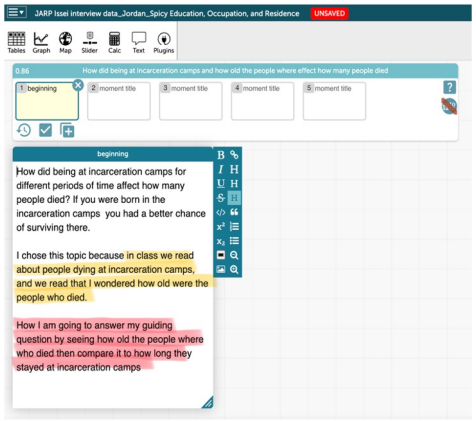
Mini Documentary

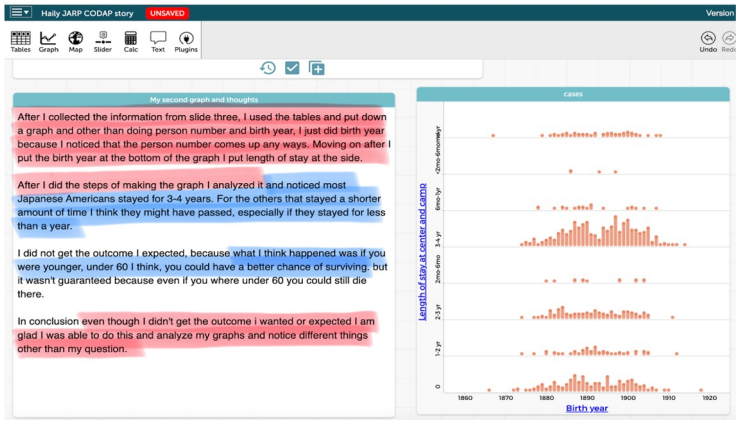
Interdisciplinary contextualizing in data storytelling

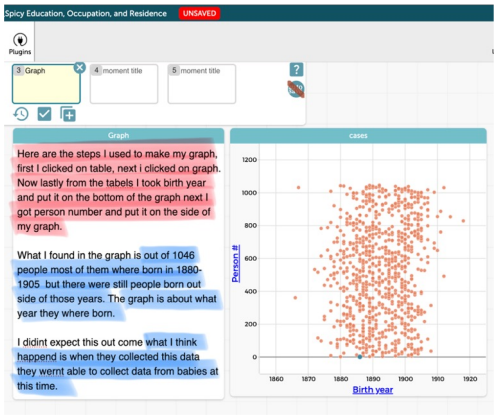
- Connecting data to oneself — Josh Radinsky's (2020) data storytelling modes of
  - "telling a story about oneself working with data"
  - "narrating oneself into a data-represented world"
- "Animating a data representation" — what is going on in the data story, including:
  - Change over time
  - Location, scale, and scope
  - Data production issues
- Linking texts — including "incorporating data into extant narratives"

Taylor's Data Story

How the length of staying in the camp might relate to the number of people who died



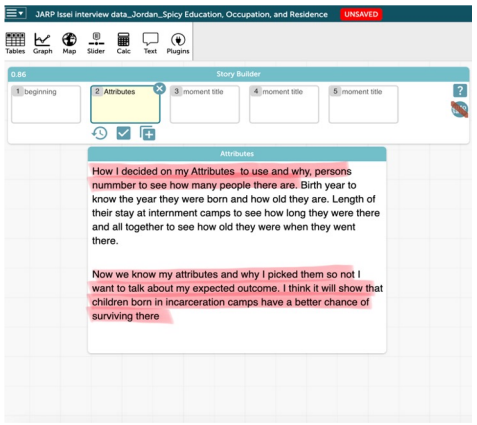


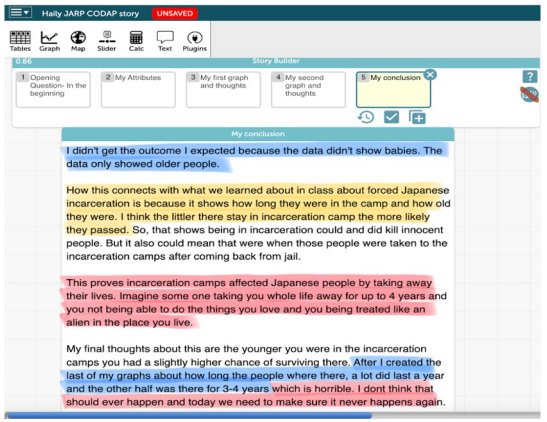


Connecting data to oneself

Animating a data representation

Linking texts





1

I chose this topic **because in class we read about people dying in incarceration camps**.

How am I going to answer my guiding question? **By seeing how old the people were**, **when they died**, then compare to **how long they stayed at incarceration camps**.

Linking to *Farewell to Manzanar* and class discussions on the experiences of Japanese Americans prior to, during, and after the incarceration.

2

"How I decided my attributes to use and why? [I chose] ***Person number*** to see how many people there were. ***Birth year*** to know the year they were born and how old they were. ***Length of stay*** to see how long they were."

Anticipated steps to structure the data in way that informed the examination

Named the attributes to support data story and explained the rationale for such decisions

Refining representation by relating Length of stay and Birth year

... I used the table and put down a graph … I did ***Birth year*** … [and] I put ***Length of stay*** at the side [of the graph].”

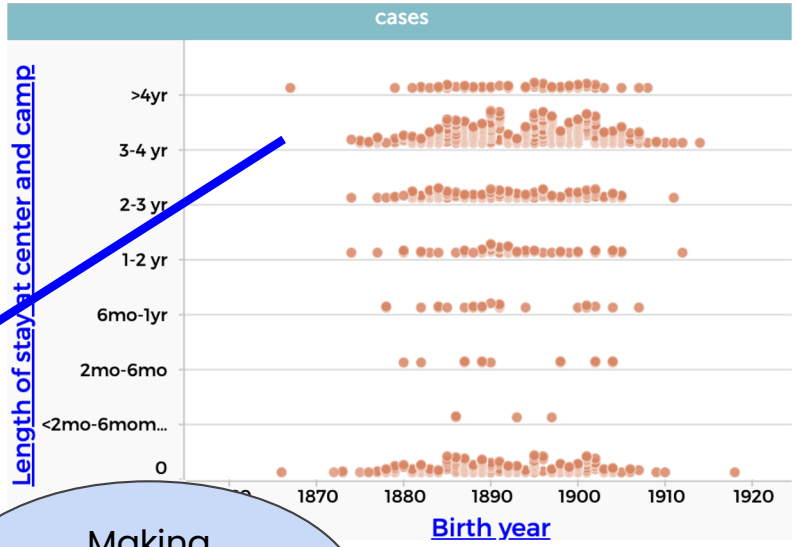
…

I noticed **most Japanese American stayed for 3-4 years.** Others stayed a shorter amount of time. **I think they might have passed especially if they stayed for less than a year.**”

…

Even though I didn’t get to the outcome I expected, I am glad I was able to do this and analyze my graphs. I noticed different things other than my question.

4

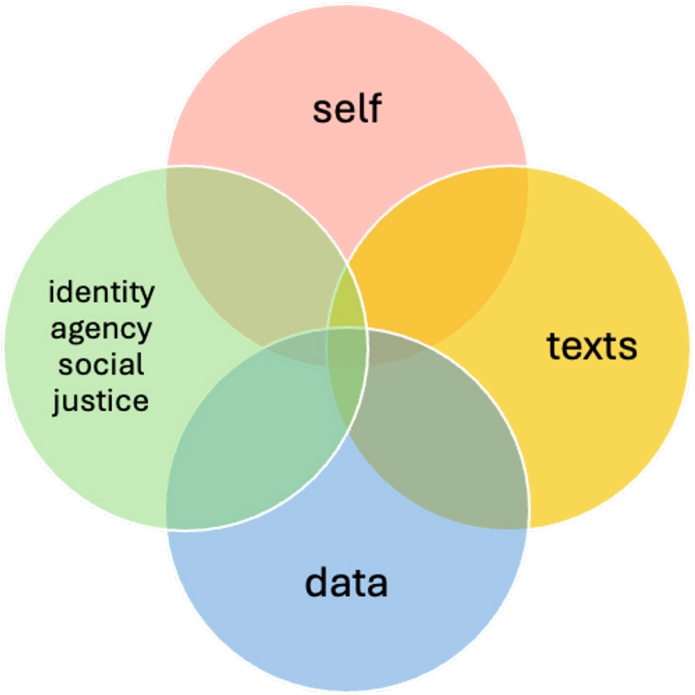


Extracting insights and pattern from data (scope)

Making inference that links to guiding question

Narrating oneself into a data-represented world

Connecting to **Farewell to Manzanar** … **my graphs show** how long Japanese Americans were in the camps and how old they were when they were there. A lot of them stayed for 3-4 years, which is horrible. **Imagine someone taking your whole life away** for up to four years, and you not being able to do the thing you love and you being **treated like an alien in the place you live.** I don't think that should ever happen [to anybody]. Today **we need to make sure it never happens again.**



Measurement efforts

- Pre- post retrospective surveys
  1. Data identification and positioning
  2. Confidence and efficacy with data
  3. Data agency and relationships
- RQ: How have 8th grade students perceived and characterized their data identification?
- Future: Interview analysis

Polman, J. L., Tran, T. C., & Miller, K. (February 2025). Towards inquiry into data identity in interdisciplinary project-based learning. Paper presented at the 2025 Data Science Education K-12 (DSE K-12) Conference, San Antonio, TX.

https://concord.org/blog/middle-school-students-see-themselves-as-data-people/

Summary of Findings

- Data Agency
- Identity Development
  - ability to use data successfully in schoolwork
  - making sense of data.
- Real-World Engagement

Figure 1. Data identification and positioning

(n=62)

1-Strongly Disagree 2-Disagree 3-Agree 4-Strongly Agree

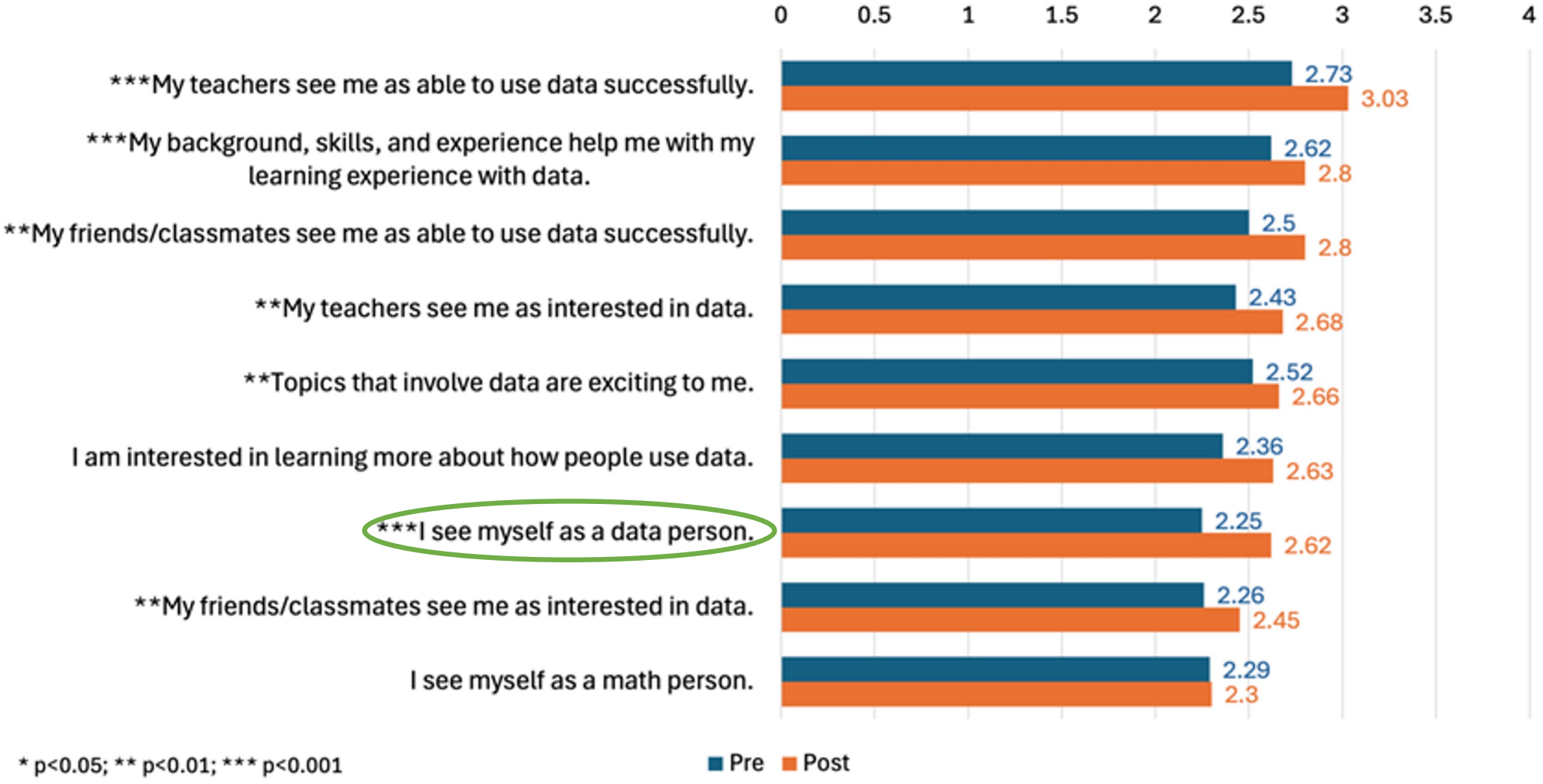
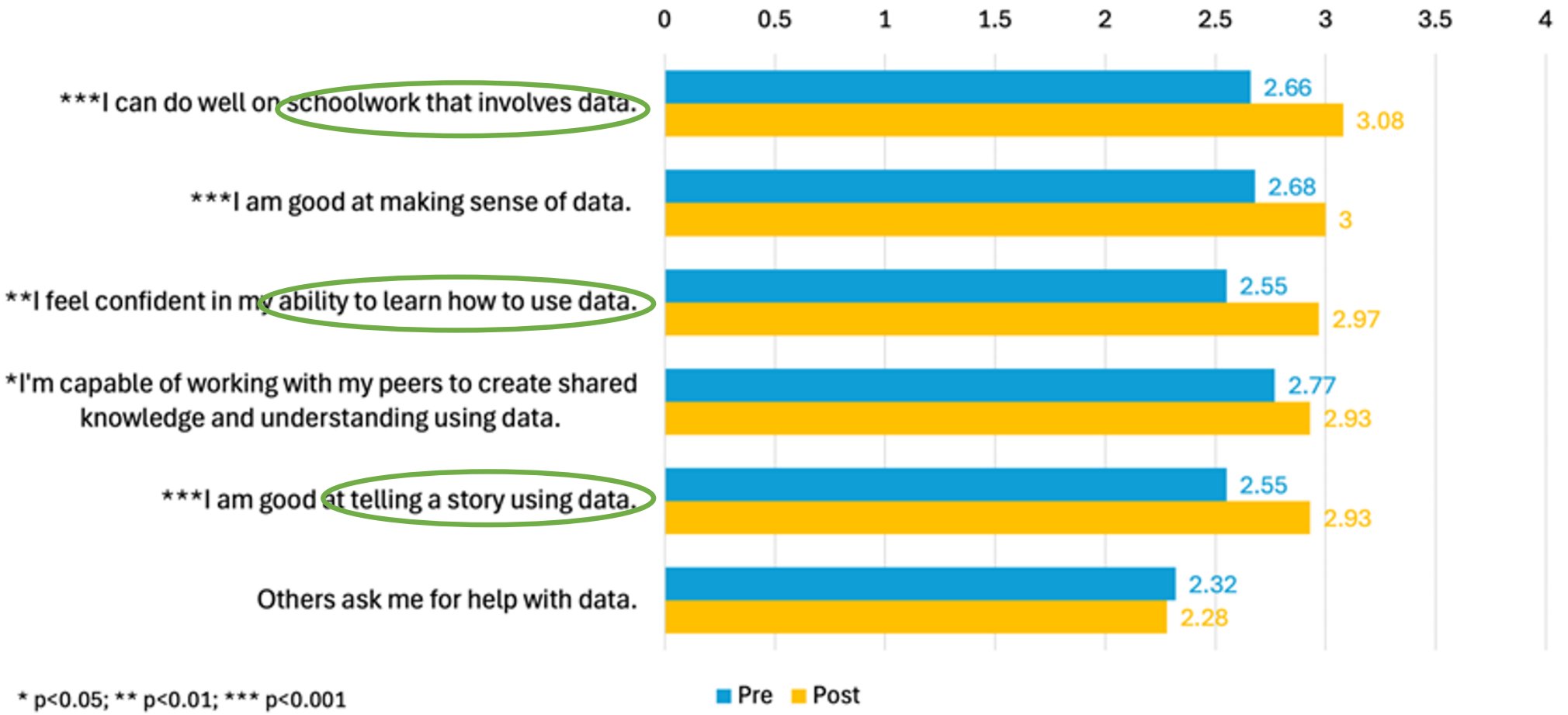


Figure 2. Confidence and efficacy with data

(n=62)

1-Strongly Disagree 2-Disagree 3-Agree 4-Strongly Agree

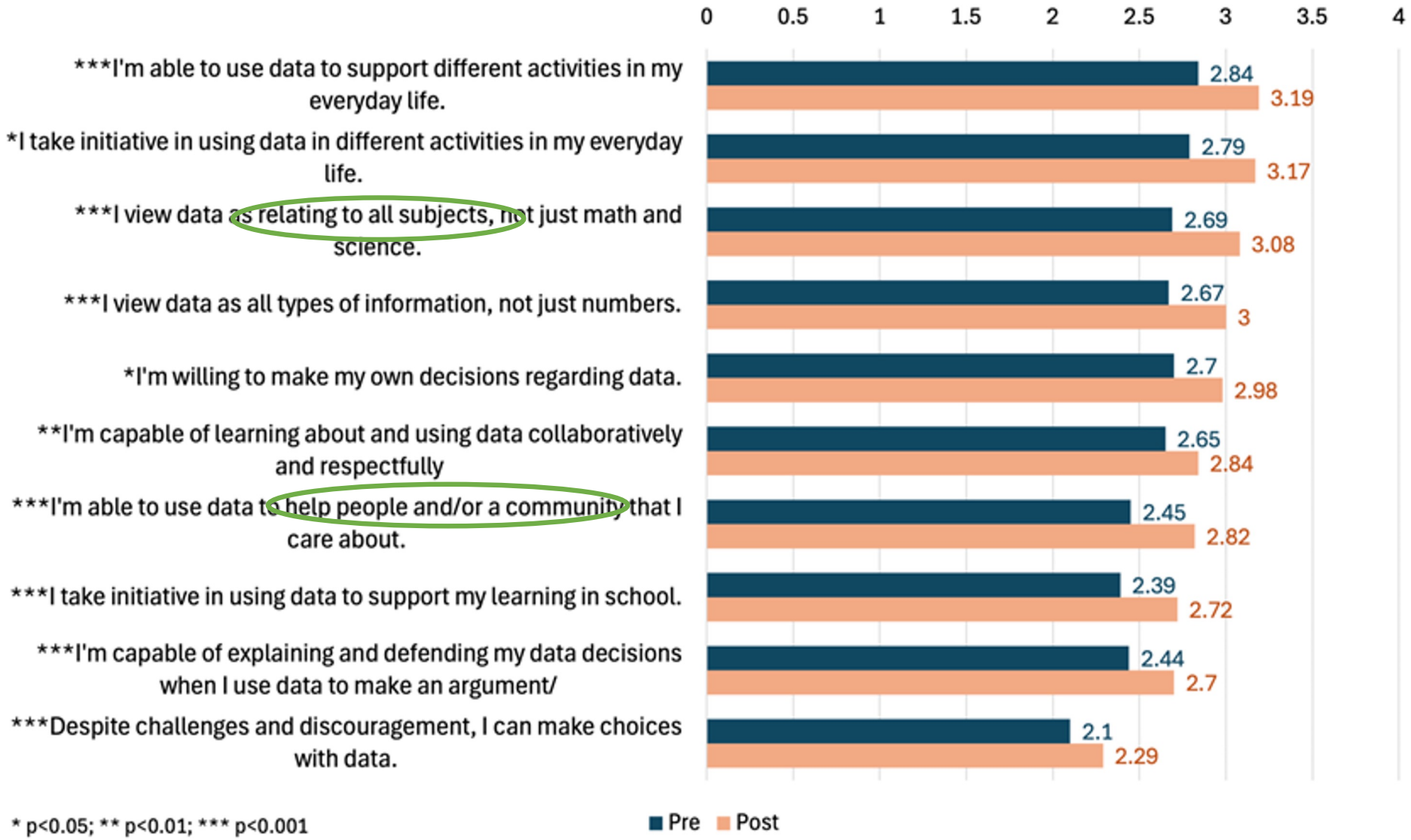


* p<0.05; ** p<0.01; *** p<0.001

Figure 3. Data agency and relationship

(n=62)

1-Strongly Disagree 2-Disagree 3-Agree 4-Strongly Agree



* p<0.05; ** p<0.01; *** p<0.001

What we're shooting for

8th grader, City in Northeast United States, Spring 2024:

"At first I **didn't like data**, like especially in seventh grade. It was really hard to use. It was lagging all the time. I **didn't see the point of using data**.

But what I kind of understand now is that history is not always believed, and you can tell a story, and it might not be the true story or might be the true story, but but not everybody is going to trust you.

And I think that's that's kind of a problem with understanding, racism and xenophobia, especially within this country, because **there's a lot of stories that go around that are not true**, like how Thanksgiving came about … [describes details] … And and I think American schooling sugarcoated things so that so that so the white kids won't feel guilty.

And so … a lot of the facts get muddled and thrown out. And **with data, we we have a clear picture of what was really happening**. And a lot of the time, well, actually, all of the time the **data supports the real story**.

So, **working with data**, I think it's it's **opening doors** for us to to understand what's actually happening and not just have an untrue story told to us."

What should DIPBL look like to foster “data people”?

- Cognitive and non-cognitive (e.g., Tran, 2025)
- Place-based
- Values are valued
- Agency and power matter
  - Agency interacts with structure …
  - … and discourse

Thank you

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