Opportunities for Research within the Data Science Education Community

Welcome, Introduce Yourself

In the chat, please introduce yourself with you **name, role, and institution**, and your response to the question:

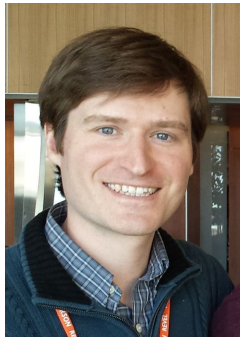
- What do you find most interesting/inspiring/challenging about data science education research?

The Facilitation Team

Chad Dorsey
Concord Consortium

Kate Miller
Concord Consortium

Ryan Seth Jones
Middle Tennessee State



David Weintrop
University of Maryland

Kirsten Daehler
WestEd

Leticia Perez
WestEd

Josh Rosenberg
University of Tennessee

Nick Horton
Amherst College

Jo Louie
EDC

State of the Field of Data Science Education Research at the K-12 Level

"Data science is in its infancy, and there is an opportunity to shape it in a way that will best serve students and future citizens. Given this early stage, there is a need to think deeply and creatively about how data science looks within K-12 and how it might develop …"

- Report from the *Foundation of Data Science for Students in Grades K-12* Workshop

Statement of Task

[Foundation of Data Science for Students in Grades K-12: A Workshop]

- What outcomes matter most for learners?
- What competencies make up data fluency?
- How can these data fluency competencies be measured?

Goals and Outcomes

Tools and Instruction

- What kinds of learning experiences might help bring about these data fluency competencies?
- What tools and data sets are needed to support young learners in acquiring data understanding and skills?
- How can K-12 data science education be designed to specifically reach students who have been traditionally marginalized and/or underrepresented in STEM?

- How can data science be meaningfully integrated with K-12 education, in both STEM and non-STEM classes?
- How well prepared is the current teacher workforce for teaching data science-related content in K-12 settings? What strategies could be used to enhance teachers' expertise related to data science?

Integrating Data Science in K-12 System

Evidence and Future Directions

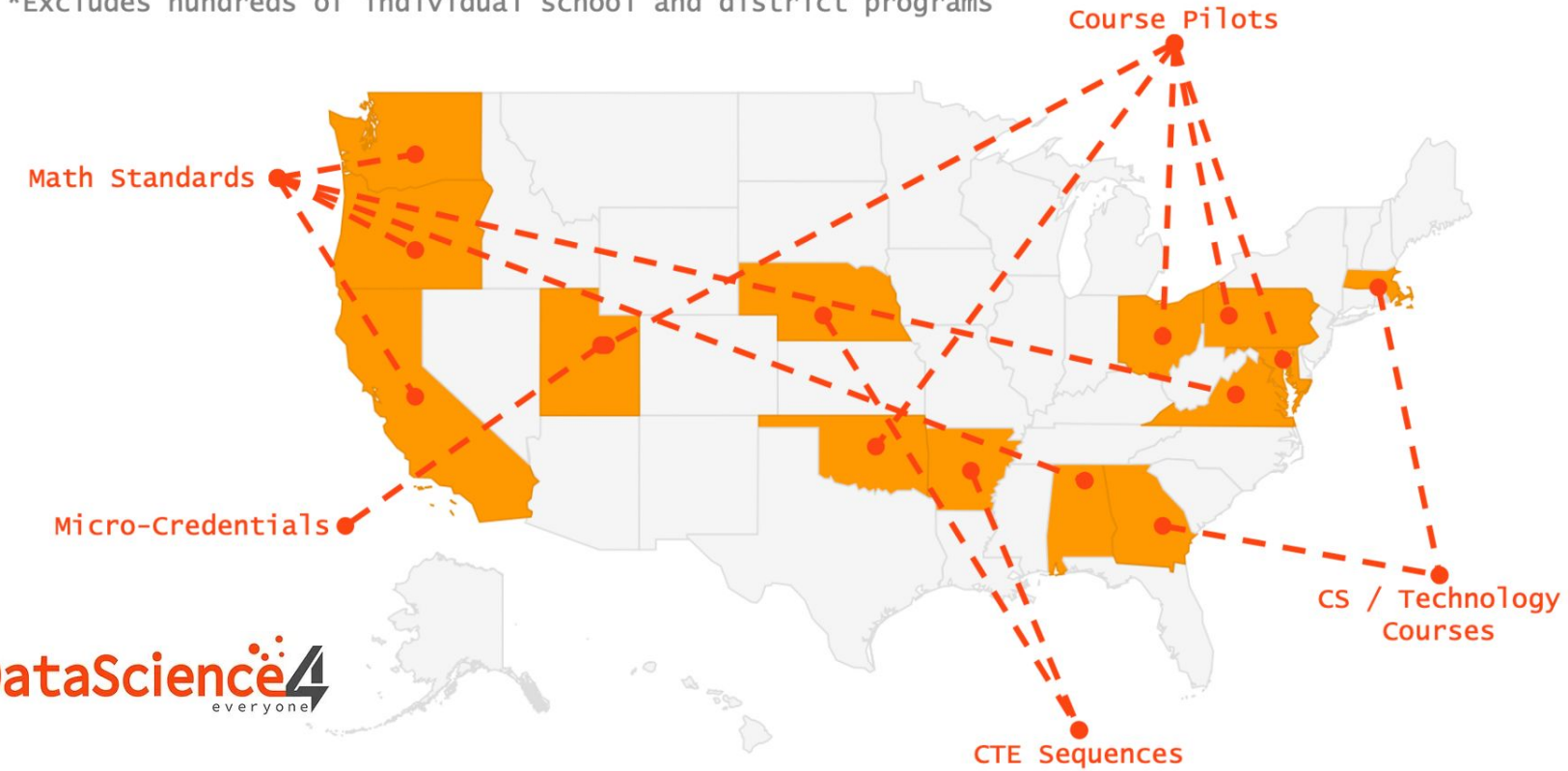
- What bodies of research can be leveraged to gain insight on the development of data fluency and how best to support students?
- What are the critical gaps in the current knowledge base?
- What are the highest priority next steps for research and practice?

NATIONAL ACADEMIES Sciences Engineering Medicine

Data literacy -> Data fluency -> Data acumen (see NASEM 2019)

Data science is growing across the country:

State-wide data science education programs (Summer 2022)
*Excludes hundreds of individual school and district programs

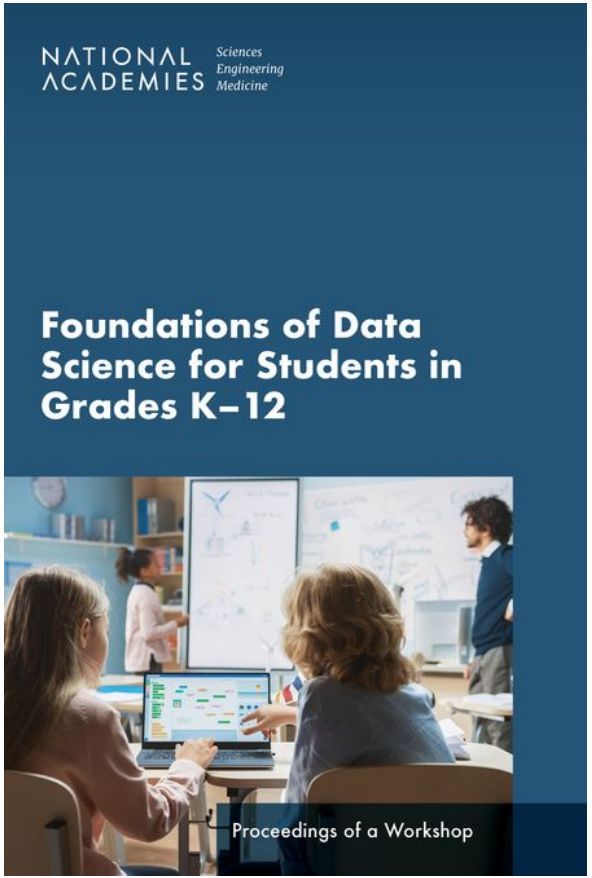


DataScience4 everyone

NATIONAL ACADEMIES *Sciences Engineering Medicine*

- Four commissioned papers
- Notes and highlights from the workshop
- Examples and cases submitted by the community
- Available for free download

[Download the National Academies Report]



Support Data Science Education Research at AERA 2023

The Concord Consortium

A curated selection of data science education sessions and events:

THURSDAY, APRIL 13

8:00 AM — **"I Felt Connected to This Data": How Students Relate to Data and Practice Argumentation (Poster 25)**
Hyatt Regency Chicago, Riverside West Exhibition Hall
Rita M. Scwartzentruber, Lynn L. Hodge, Joy Gaulden Bertling, Amanda Galbraith, Tabitha Wandell

9:50 AM — **Examining How Students Code With Socioscientific Data to Tell Stories About Climate Change (Poster 49)**
Hyatt Regency Chicago, Riverside West Exhibition Hall
Changzhao Wang, Hamid Sanei, Rabia Yalcinkaya, Shiyan Jiang, Jennifer Kahn

Integrating Data Literacy Into Social Studies Education With Discipline-Specific Visualization Tools (Poster Symposium – Poster 1)
Radisson Blu Aqua Hotel, Chicago, 1st Floor, Atlantic E
Mark J. Guzdial, Tamara L. Shreiner

11:40 AM — **Critical Media, Information, and Data Literacies (Roundtable, Table 10)**
Fairmont Chicago Millennium Park, B2 Level, Imperial Ballroom
Karis Michelle Jones, Chair

2:50 PM — **Foundations of K–12 Data Science Education (Symposium)**
Regency Chicago, West Tower - Ballroom Level, Regency C
Amy Stephens, Chair

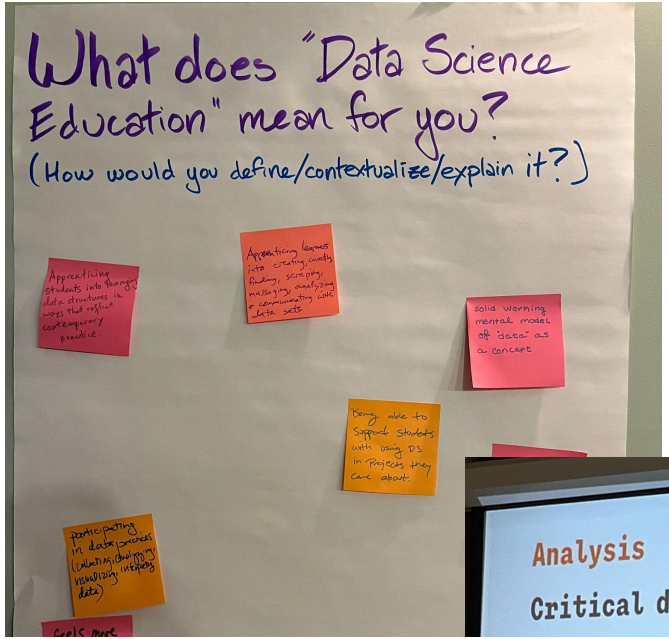
Emotion in Analyzing and Interpreting Data: Implications for Children's Considerations of Distribution and Variation in Elementary Science (Paper)
Hyatt Regency Chicago, West Tower - Ballroom Level, San Francisco
Kathryn Lanouette

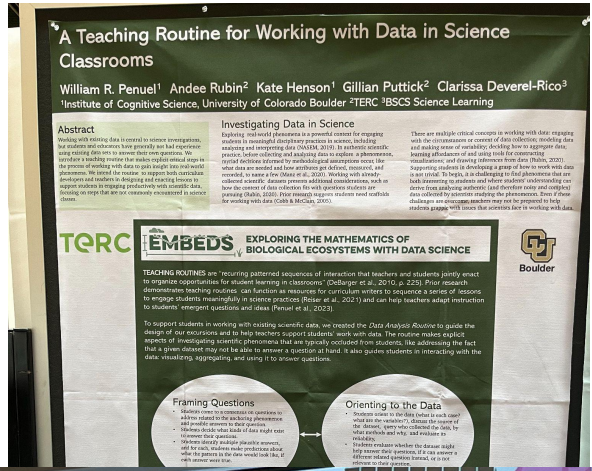
Out-of-School STEM Learning: Youth-Driven, Applied Data Science Addressing Needs in Their Own Communities (Demonstration by Youth)
Radisson Blu Aqua Hotel, Chicago, 2nd Floor, Pacific 1 & 2
Malik S. Henfield

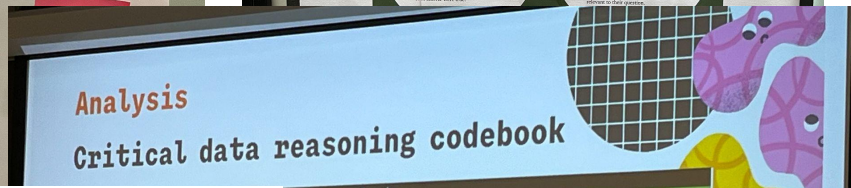
4:40 PM — **Toward a Framework for Justice-Oriented Data Science Education in K–12 Schools (Paper)**
Hyatt Regency Chicago, East Tower - Concourse Level, Michigan 2
Bodong Chen, John Bartucz, Cassandra Scharber, Vimal V. Rao, David DeLiema

A Teacher Case Study on Integrating Music and Data Storytelling for Elementary School Students (Paper)
Swissôtel Chicago, Event Centre, 1st Floor, Zurich D
Golnaz A. Irgens, Ashton L. Fisher, Danielle C. Herro, Ibrahim O. Adisa, Dara Abimbade

5:00 PM — **Building Data Literacy for Every Student: Illinois Meetup**
University of Chicago Gleacher Center *450 North Cityfront Plaza Drive*
RSVP







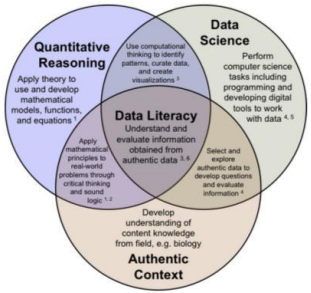
Defining Data Literacy as a Form of STEM Integration

The ability to understand and evaluate information obtained from authentic data

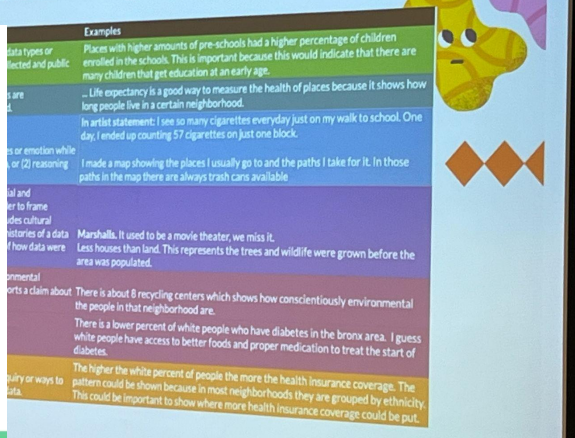
Quantitative Reasoning: mathematical models, functions, and equations

Data Science: Programing and developing digital tools to work with data

Authentic Context: Content knowledge from the field, e.g. biology



Kjelvik & Schultheis, 2019



Breakout Rooms

Choose your own adventure

NOTES

- Defining DSE Within and Across Disciplines
- Supporting Teachers for Teaching DSE
- Diversity, Equity, and Inclusion in DSE
- Tools and Tool Design for DSE

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Discussion

1. What are some highlights / takeaways from your discussion?
2. What about your breakout room was especially useful?

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Resources for DSE Research

Conferences (1 of 2)

American Educational Research Association (AERA)

- Pros: Diverse attendees, multiple divisions and Special Interest Groups (SIGs) with interest, NEW SIG for Data Science Education Soon!
- Cons: Large and vast, No centralized community for data science education

International Society of the Learning Sciences (ISLS)

- Pros: Smaller and more focused, strong theoretical foundation, history of interdisciplinary work across math and science (and recently more disciplines)
- Cons: Sometimes difficult to get to since locations move across different countries

Statistics Education Conferences (USCOTS, ICOTS, JSM, etc.)

- Pros: Strong emphasis on statistics as a discipline, established community dedicated to teaching and learning of data, statistics, and modeling
- Cons: Largely high school and undergraduate focus, less focus on knowledge about learners, most research is framed and conducted within a statistics or mathematics classroom

Mathematics Education Conferences (PME-NA, NCTM, ICME, etc.)

- Pros: Sessions and interest groups on data and statistics, often strong connections to statistics education communities, strong mathematical focus, often confused on learner thinking
- Cons: Frames DSE as a mathematics activity and places emphasis on mathematical thinking

Conferences (2 of 2)

- **Science Education Conferences (NARST, NSTA, TSTA, etc.)**
  - Pros: Data are used in scientifically meaningful contexts to generate claims, DSE is integrated into diverse forms of inquiry, DSE is connected to other scientific practices
  - Cons: Less emphasis on learning about data and the statistical reasoning necessary for certain types of inquiry and modeling
- **Computer Science Education Conferences (SIGCSE, ICER, RESPECT, CSTA, etc.)**
  - Pros: Venues with expertise on programming and computational aspects of data science
  - Cons: Data science will only be a small sliver of the overall program
- **Human-Computer Interaction Conferences (IDC, CHI, VL/HCC, etc.)**
  - Pros: a community of people who can (and are) building tools to make data science accessible/intuitive
  - Cons: often don't know much about learning or education

Journals (1 of 2)

- **Journal of Statistics and Data Science Education**
  - An open access peer-reviewed journal published by the American Statistical Association (no APC)
  - It disseminates accessible knowledge for the improvement of data science and statistics education at all levels
- **Journal of the Learning Sciences (JLS)**
  - One of the two official journals of the International Society of the Learning Sciences
  - It provides a multidisciplinary forum for research on education and learning that informs theories of how people learn and the design of learning environments.
- **Statistics Education Research Journal**
  - Journal of the International Association of Statistics Education with research on teaching, learning, and understanding of statistics and probability.
- **British Journal of Educational Technology**
  - Journal of The British Educational Research Association
  - It publishes research that demonstrate how applications of instructional/educational technology systems, tools and resources lead to improvements in education

Journals (2 of 2)

- **The American Statistician**
  - Publishes articles on statistics, statistical practice, statistics teaching (Teachers Corner), and statistical computing and graphics.
- **Harvard Data Science Review**
  - An new open-access venue (no APC) aspiring to be “a global forum on everything data science and data science for everyone”
- **Mathematics Education Journals (JRME, JMB, MTL, ZDM, etc.)**
  - Mathematics education journals often have research on data science education within a mathematics class context.

Data Science Education is not a closed community, and most of us come to it from other disciplinary backgrounds. We want you to join and see yourself as a contributor!

DSE Research Community of Practice Database

Database

Contact Edits Form

Publication Edits Form

If you have any inquiries, please reach out to Kate Miller at kmiller@concord.org

The Concord Consortium has created a public database with the support of the Valhalla Foundation to foster a community of practice centered on data science education at the K-12 level. The purpose of this database is to facilitate an understanding of the community and the sharing and viewing of literature related to the field among community members.

The DSE CoP base offers several key features, including a public gallery view of contacts, a downloadable CSV file of contacts in a grid view, a grid view of publications available for download in CSV format, and links to forms for revising or adding to the dataset.

Please use the links to the left to access the main database and the forms for edit requests

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Funding & Grant Opportunities

- Innovative Technology Experiences for Students and Teachers (ITEST)
  - Focused on equitable and inclusive integration of technology into STEM instruction
  - Emphasis on **preparation for future workforce**, inclusion of **underrepresented and/or underserved** groups, and leveraging strategic and **community partnerships**
  - Projects can occur in **formal or informal settings**
  - **Mid-August** deadline, three project types, awards from **$500K to $3.5M**
- EDU Core Research (CORE)
  - Focused on **fundamental research** into general, underlying explanatory knowledge
  - Accepts projects in three areas: STEM Learning and Learning Environments, Broadening Participation in STEM, and STEM Workforce Development
  - Projects can occur in **formal or informal settings**
  - **Early-October** deadline, three proposal levels, awards from **$500K to $2.5M**

Funding & Grant Opportunities

- Discovery Research PreK-12 (DRK12)
  - Focused on **research and development** for STEM **teaching and learning**
  - Projects occur or focus on **formal PreK-12 settings**
  - Accepts projects in two strands: **Learning and Teaching**
  - **Early-October** deadline, three proposal levels, awards from **$450K to $5M**
  - Also a new **Partnership Development** project type—$100K for one year
- Advancing Informal STEM Learning (AISL)
  - Focused on **design, development and impact** of STEM learning opportunities and experiences **for the public**
  - Projects occur in **informal education settings**
  - Accepts projects for **Partnership Development and Planning**, **Integrating Research and Practice**, and **Research in Support of Wide-reaching Public Engagement** with STEM
  - **Early-January** deadline, awards from **$50K to $3.5M**

Funding & Grant Opportunities

- Research on Emerging Technologies for Teaching and Learning (RETTL)
  - Focused on exploratory and synergistic research in emerging technologies
  - Emphasis on **learning, teaching, or a combination of both**
  - Broad scope: projects can occur in **formal or informal settings** and may; **not required to focus on STEM**-related teaching and learning
  - **Fall** deadline (new solicitation coming?), past awards up to **$850K**
- Improving Undergraduate STEM Education (IUSE)
  - Focused on improving STEM teaching and learning for **undergraduate students**
  - Also interested in **transforming institutions** to adopt successful STEM education practices
  - Accepts projects in two tracks: **Engaged Student Learning** and **Institutional and Community Transformation**
  - Projects occur in **formal undergraduate settings**
  - **Mid-July and mid-January** deadlines, two/three levels, awards from **$200K to $2M**
  - Also includes **Capacity-Building awards** to enable institutions new as primary to Institutional and Community Transformation to identify a project of interest

Curriculum and Tools – Collection (start here)

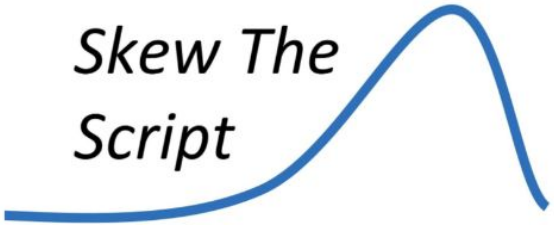
Data Science for Everyone (DS4E)
Resource Center "Teaching Data Science" (link)
Great site with resources that are searchable by grade level and category (e.g., Course Curriculum, Lesson Plans, Tools & Software, Professional Development). The Resource Center also identifies places to look for educator-friendly datasets and opportunities for learning data science.

Curriculum and Tools – Math focused

CourseKata Statistics & Data Science (link)
An interactive online textbook for teaching introductory statistics and data science in colleges, universities, and high schools, that includes more than 1500 formative assessment questions.

Passion Driven Statistics (link) — statistics and data science problem based learning (PBL) course

Skew the Script (link)
Free, relevant, and data-rich math lessons specifically for AP Statistics and Algebra I/II learners that situate in relevant contexts. The lessons challenge students to tackle relevant questions (e.g., Is college worth the price?) with statistics, mathematics, and critical thinking.



Curriculum and Tools – Science-focused

Cosmic Data Stories (link)
Engaging, interactive data stories, that allow learners to interrogate the data behind the story on their own, using data science and visualization techniques.

MY NASA DATA (link)
Lesson plans, mini lessons, data visualizations, and story maps that integrate Earth System Science data associated with the atmosphere, biosphere, cyrosphere, geosphere, and hydrosphere.

SERC Earth Exploration Toolbook (link)
A collection of online Earth system science activities from the Science Education Research Center (SERC) at Carleton College. Each activity, or chapter, introduces one or more scientific data sets and analysis tools that enables users to explore some aspect of the Earth system.

Curriculum and Tools – Other

Anaconda (link) — a community platform with educational tools and support for everything Python

Census Academy (link)— how to use the "American Community Survey: A Comprehensive Look"

Data4Kids: data stories – Urban Institute (link) — a set of tools and resources to help teach kids in primary and secondary school about data, data science, and data visualization in a virtual environment

Makeover Monday (link) — a community that comes together every Monday to work with a given data set and create better, more effective visualizations and help us make information more accessible

Power of Data Science PBL modules (link) — modules that provide opportunities for project-based learning around key ideas of data science in the context of relevant, real-world explorations and experiences

Slow Reveal Graphs (link) — an instructional routine that promotes sensemaking about data

SERC Using Data in the Classroom (link) —information for educators and resource developers interested in effective teaching methods and pedagogical approaches for using data in the classroom

Statistics and Data Science for Teachers (link) — this book empower teachers and teacher educators to teach statistics and data science in a way that is rich and relevant

USS-DATA (link) — modules designed to promote high school students' statistical thinking and data literacy skills through investigations of social and economic conditions in the U.S.

Tools

CODAP Story Builder (link) — allows students to record and replay steps of their data analysis. It also allows for integration of text, images, videos, news stories, and other multimedia resources

Glue (link) — an open-source Python library to explore relationships within and between related datasets

Fathom (link) — dynamic software for teaching data analysis

FieldScope (link) — map-based data collection and analysis platform that supports community and citizen science

Integrated Statistics Learning Environment (link) — browser-based interactive statistics & data analysis platform

TinkerPlots (link) — a data visualization and modeling tool developed for use by middle school through university students

Zooniverse (link) — a platform for people-powered research

Other Links Collected from Chat

http://www.data8.org/

http://instepwithdata.org

https://www.cs.utep.edu/DataMiner/index.html

https://terpconnect.umd.edu/~weintrop/papers/Israel-Fishelson_et_al_LDT_2023.pdf

https://www.amazon.com/Weapons-Math-Destruction-Increases-Inequality/dp/0553418815

The NIH SEPA program (https://nihsepa.org/) has interest in data science education in the context of biomedical research

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JOIN the Data Science 4 Everyone Slack Channel

concord.org

What questions do you still have?