DATA LITERACY

October 15, 2021, 2:00 – 3:30 PM ET
DISCLAIMER

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CONTEXT: DATA ON DATA SCIENCE

• Top Jobs Demanded in 2020 Globally (World Economic Forum)
• Top 10 Jobs in 2017, 2018, and 2019 (LinkedIn)
• Top 5 Skillsets Demanded since 2014 (LinkedIn)

We know these skillsets are important for personal finance, health, and civic engagement.
NATIONAL SPREADSHEET DAY
OCT 17
DEPUTY SECRETARY
CINDY MARTEN

U.S. Department of Education
TRENA WILKERSON

President, National Council of Teachers for Mathematics
Data Literacy

Data Science Mathematics, Statistics, and the Disciplines

Trena L. Wilkerson, NCTM President
Professor of Mathematics Education
Baylor University

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Key Considerations

- Understand and critique our world
- Expand opportunities
- Critical thinking skills are essential
- Vital for both STEM and non-STEM fields
- Imperative for all students
- Make connections across and within disciplines/fields - Understanding Context
Fostering data literacy includes fostering mathematics, statistics, quantitative, media, and discipline specific literacy to equip students with the knowledge and resources needed to make sound, informed decisions and to solve problems arising in their personal and professional lives as members of society.

Partners & Stakeholders

- Families/Caregivers
- Communities
- Teacher Educators
- Businesses
- Schools-teachers, administrators, school boards, Pk-12+
- Post-Secondary Education
- Curriculum & Assessment Writers/Developers
Data Literacy

- Equity Stance/Lens
- Build/foster/support positive identity
- Inclusive across Pk-12
  - Meaningful, thoughtful approach
- Rethink/Reimagine statistics education
- Interdisciplinary approach
- How to support ALL teachers in this work
An imperative!

The development of statistical thinking is an imperative today. Every individual must be able to synthesize data to support decision making, make sense of our world, and prepare for the future.

November 2020 President’s Message (Wilkerson)
An Imperative for Our Future

“Making a difference will require collaboration, communication, and work across diverse groups and communities, but engaging in these conversations is our collective responsibility to the students of today and tomorrow, as well as to our democratic society at large”

(Catalyzing Change in High School Mathematics: Initiating Critical Conversations, NCTM 2018, p. 93)
JO BOALER

Nomellini & Olivier
Professor of Education,
Stanford University
Director, youcubed
Introduction – Youcubed Data Science

Jo Boaler,
The Nominelli-Olivier Professor of Mathematics Education
@joboaler
• Our goal is to share free resources for teachers & students showing the beauty and creativity in open mathematics & data science
• Over 53 million visits to website in last 5 years
• Hundreds of free tasks & lessons K-16
• Used in 2/3 of US Schools
• 145,000 newsletter subscribers
• TEDx talks – over 1.5 million views
• Newsletters opened in over 160 countries
Data Science K-12 is highlighted.

Data Science can be an equitable pathway.

California Mathematics Framework

youcubed at Stanford University
High School Pathways – in California and beyond

California Mathematics Framework, 2022
BIG IDEAS
A Selection of Big Ideas from Data Science – from GAISE II (2021).

Co-author: Rob Gould

Integrating data science into the content being taught

- Formulate statistical investigative questions
  - Formulate statistical investigative questions
  - Students generate ideas and ask questions – creating and refining statistical investigation questions

- Collect/consider data
  - Students learn what counts as data (e.g., visuals, sounds, numbers, categories) and understand that people collect data to answer questions
  - Students develop

- Analyze data
  - Students develop ways to represent and interrogate data to notice, describe, and analyze patterns
  - Students recognize variability and use technology to develop models that incorporate

- Interpret and communicate
  - Students decide key results to include in a data report that answers the statistical investigative question
  - Students communicate their results through, for example, a data visual, a
Example of “Big Ideas” for Grades 1-2

Over 10,000 visits since Monday!!
Online Class to excite teachers about data science

What is Data Science and why it is important?

Teaching Examples – Classroom Video

CODAP Explorations

Teaching Content – Probability & Statistics

Student Videos for Use in Classrooms

Part of the State of Utah Data Science Credential

Facebook group: 2.7K members
K-12 Data Talks

• What do you notice? • What do you wonder? • What is going on in this data visualization?
Stephen Curry Is One Of The Best
All of his shots, 2015-16 regular season

• What do you notice?
• What do you wonder?
• What is going on in this data visualization?

https://fivethirtyeight.com/features/stephen-curry-is-the-revolution/
Arctic Sea Ice Data Example

Average Monthly Arctic Sea Ice Extent
November 1978 - 2020

Year

Extent (millions of square kilometers)


National Snow and Ice Data Center

Pola Bear declines
A **living wage** is a wage that is high enough to maintain a normal standard of living.  
A **minimum wage** is the lowest an employer can pay an employee for their work.  
A **housing wage** is an estimate of the hourly wage a full-time worker must earn to afford a modest rental home without spending more than 30% of their income on housing costs.
Youcubed – data science – data talks

Over 100,000 Downloads
Youcubed Data Science Resources: Grade 6-10 Lessons

Lessons

Teacher Online Course: 21st Century Teaching and Learning
Unit 1: Data is Everywhere
Unit 2: Working With Data Analysis Tools
Unit 3: Measures of Center & Spread
Unit 4: Understanding Variability
Unit 5: A Community Data Collection Project

Over 30,000 downloads
High School Course:
Explorations in Data Science:
Youcubed Adaptable Curriculum

Partnered with
Google & Tableau
Youcubed Adaptable Curriculum— in partnership with Google

- Free with low Barrier for Entry
- Widely Accessible Tools
- Low-Floor, High Ceiling – Project based
- Live and Current Datasets
- Use of Local & Customizable Data
- Broad Flexibility for Individual Settings
Academic Advisors and Industry Advisors

Talithia Williams
Dept of Mathematics
Harvey Mudd

Rachel Levy
Mathematician

Elena Grewal
Previously Head of Data Science
Airbnb

Evan Shieh
Data Scientist
Amazon

Rob Gould
Dept of Statistics
UCLA

Steve Levitt
Economist
University of Chicago

Jeff Feng, Airbnb
Head of Machine Learning

Ellen Huynh, Airbnb
Senior Program Manager
Project Based

Youcubed: Explorations in Data Science: 8 Units

- Data tells a story
- ACS Data Distributions
- Bivariate Data
- Probabilistic Modeling tells a story
- Data Categorical tells a story
- Modeling with Data
- Data Predictions
- Being a Data Scientist

A Project Based One Year Course
Encouraging Student Agency

Students ask their own questions & investigate data sets from their own communities
What will students learn?

Tableau

Colab

CODAP

Python
The mathematics of high school data science

- Statistics
- Probability
- Matrices
- Linear Algebra
- Computational Thinking
- Programming
Who is taking our data science course?

• 1500 accounts made, 100,000 page views
• This year - 575 teachers in 500 different schools/districts
  (220 have been to our PD)
• Over 30,000 students
  • 46% girls/non-binary
  • 40% students of color
  • 58% not mathematically accelerated

High School Professional Development Workshops @youcubed. In person and online
**Data Science**

- This is the most interesting course I have taken. An profound analyzation of data feels like deciphering a crime scene for clues.

- It's fun. It's like you're a research expert.

- Everyone is involved in group projects no matter what, which is what makes it a great course.

**In comparison to other classes**

- It's a well thought class that does not overload you with work and tests.

- Even the grading scale is fair & I won’t worry if I need to fix an assignment.

- This course definitely surprised me after being enrolled to it for a month now. I enjoy it a lot more than I thought. From how the grading works, to the curriculum, or the communication this class has. It’s such a great way of learning along with it also being a very enjoyable class.
Challenge

Data Science

• This data science course is challenging but in a good way.

• I think it can be very challenging but working groups and the help of our teacher, it’s more understandable.

• I would describe it as challenging, fun, and creative because some tasks are challenging and yet you get to be creative.

Other Maths Classes

• In normal integrate/pre-cal classes I’m always lost and behind.

• I think this course is interesting and funner to learn. I am enjoying it because there is more group discussion and more projects so you aren’t just sitting in class bored and confused.
Learning from Data Science

• Data science is something you will eventually need. I personally recommend it to anyone who’s thinking of it. It's the class of the future.

• I really like this class and I hope to see it being added to more high schools

• It's a class that helps with deep thinking on data that helps to understand how data is collected and useful. It brings the side of critical math thinking that I didn't know I had

• I realized many things about myself and other things I like ever since I’ve been in this class.
Initiative to Change University Admissions

Stanford change...

**Mathematics:** four years of any rigorous mathematics incorporating a solid grounding in fundamental skills (algebra, geometry, trigonometry). We also welcome preparation in skills related to statistics, data science and calculus.
Data Science throughout K-12

- New Initiative from the State of California
- Big Ideas instead of standards
- Mathematics writing team: Jo Boaler & Cathy Williams
SUYEN MACHADO

Co-Author, Introduction to Data Science
UCLA, Center X
Introduction to Data Science (IDS) for High School Students

Suyen Machado
Co-author & Director, Data Science Project
University of California, Los Angeles
Introduction to Data Science
The Data Science Test

- Awash in Data
- Data Moves
- Data Properties

https://bestcase.wordpress.com
IDS Components

Introduction to Data Science

Robert Gould
Suyen Machado
Terri Anna Johnson
James Molyneux

IDSWEB Tools

Year-long Curriculum + Technology Suite + PD
Introduction to Data Science

IDS Curriculum

Unit 1 - Data and Visualizations
Unit 2 - Distributions, Probability, and Simulations
Unit 3 - Data Collection Methods: Traditional and Modern
Unit 4 - Predictions and Models
The Data Cycle

1. Ask questions
2. Consider data
3. Analyze data
4. Interpret data
5. Research topic
LESSONS  LABS  PROJECTS
IDS Technology

Web Tools

R Studio

Participatory Sensing
PARTICIPATORY SENSING

An approach to data collection and interpretation in which individuals, acting alone or in groups, use their personal mobile devices and web services to systematically explore interesting aspects of their worlds, ranging from health to culture.
Professional Development

SCALE Immersion Model for Professional Learning (SIMPL™)

IDS Professional Development

Year 1

9 days

Year 2

4 days

IDS Implementation

Deeper dive into:
R Skills, Concepts, Pedagogy
EMMANUEL SCHANZER
Bootstrap Data Science,
Brown University
We made a controversial bet...

- Siloed classes aren’t the only way to do this

- Integrate computing & math authentically

- There’s a way to do it equitably, for all students
15 years later....

- One of the largest providers of in-school CS nationwide
- One of three curricula cited by the NSF
- ~43% girls and young women, ~46% black and latinx students
- Taught almost entirely by non-CS teachers with no computing background, in non-CS classes!
Ingredients for K-12 Data Science

Statistics

Computing
Ingredients for K-12 Data Science

```python
def add5(x):
    return x+5

def dotwrite(ast):
    nodename = getNoden
    label=symbol.sym_na
    print ' %s [labe
    if isinstance(ast[1
      if ast[1].strip(
        print ' = %s"
      else:
```
Responsible K-12 Data Science

- Computational Concepts
  - Problem decomposition
  - Reliability
  - Reproducibility

- Bootstrap been focused on these concepts since the 1990s

- “Coding” doesn’t touch ANY of them!
Responsible K-12 Data Science

- Statistics
- Computing
- Civic Responsibility
- Domain Investment
"New Math" 2.0

- We want to **unleash the power of data**, across the curriculum.

- We use **free tools** - a disciplined approach
  - Elementary school: **spreadsheets**
  - Middle school: **CODAP (which we have extended!)**
  - High school: **Pyret**

- We build **free curricular materials** for grades 5-12

- An **interdisciplinary challenge** requires an **interdisciplinary team**

- We **design for integration**, creating on-ramps for teachers in every subject, at every level - **at scale**.
Find the path that’s right for your school or district

Access totally-free curriculum and tools

Curriculum, Training and Pedagogy designed for integration

schanzer@BootstrapWorld.org
RESOURCES

- Education Materials
- Forthcoming Guidance Resources
- Federal Funding Opportunities
Education Materials & Resources

• **NASA / Microsoft “Day of Data”** – modules for using spreadsheets to explore space data in classroom settings.

• **U.S. Census Statistics in Schools Program** – lesson plans and other resources across K-12 subjects, including math, history/social studies, geography, and English

• **U.S. Census Academy** – one- or two-hour courses on using Excel, R, and Census Data. Most relevant for adult learners and teachers.

• **Data.Gov** – a centralized housing for open Federal datasets.
Forthcoming Guidance

Checklist for Building Data Science Education

The Department's model for the implementation—and continuous improvement—of evidence-based interventions, including those related to data education and data literacy, includes five steps.

The following checklist summarizes the key components of each step. You can also download the checklist here.

1. Identify Local Needs

   - Consult existing learning-based requirements and student needs
   - Meaningfully engage local stakeholders
   - Seek systematic alignment with post-graduation pathways
   - Consider piloting first, and design for long-term goals
   - Determine outcomes that matter most to your context and locality

2. Select Relevant, Evidence-Based Interventions

   - Select programs that demonstrate a clear rationale and support infrastructure
   - Select programs that reflect components of evidence-based practices
   - Explore prior pilot programs and results from peer schools and districts
Soon Available on What Works Clearinghouse
Funding Resources for Supporting Data Science in K-12

- American Recovery Plan ESSER Funds (includes any ESEA activity)
- Elementary and Secondary Education Act (ESEA) Title IV Part A Funds
- Teacher Quality Partnerships (TQP)
- Supporting Effective Educator Development (SEED)
- Education Innovation Research (EIR)
- Education Research Grants (ERG)
- Federal Communications Commission E-Rate Program
- NSF Harnessing the Data Revolution (HDR) Program
- NSF Research on Learning in Formal and Informal Settings (DRL)
ARP ESSER Funds

• Any activity authorized under ESEA is eligible.

• Additional eligible categories include:
  • **PD**: partnerships with PD programs, hiring & retention, technology training & literacy, and financial support, including student loans for educators (sec. D-1)
  • **Hardware**: laptops, tablets, tech accessories, and assistive technology (sec. C-19)
  • **Software**: software/online/virtual programs and online/virtual/cultural curriculum/programs (sec. C-19)
  • **Internet**: improvements in technology infrastructure, operations, and use (sec. C-19)
  • **Out of School Time**: online program, course development, hardware, or other materials (sec. C-2, C-13)

• **Must spend by 2023** – invest in long-term contracts where possible.
Regular ED Grant Programs

- **Teacher Quality Partnerships (TQP)** – funds collaborations between eligible K-12 districts and Institutes of Higher Education for teacher training

- **Supporting Effective Educator Development (SEED)** – develop, expand, and evaluate evidence-based practices for teacher training

- **Education Innovation Research (EIR) Early Phase Grants** – create, develop, implement, replicate, or take to scale field-initiated innovations

- **Education Research Grants (ERG) STEM Topic** – research on the improvement of students' STEM knowledge and skills
Other Federal Grant Programs

- **ED Office of Education Technology Grants Hub** – centralized resource of all technology-related grants and programs.

- **FCC E-Rate** – discounts for telecommunications, Internet access, and equipment to eligible schools and libraries. **See also COVID Emergency Connectivity Fund.**

- **NSF Harnessing the Data Revolution** – an umbrella program covering three grant areas for graduate scholarships, data science field research, and data science institutes.

- **NSF Division of Research and Learning** – relevant programs for data science education include DRK-12, ITEST, and AISL solicitations.
National Council of Teachers of Mathematics (Presenter: Trena Wilkerson| Contact: nctm@nctm.org)

Books
- Catalyzing Change Series: https://www.nctm.org/change/
- K-12 Guidelines for Assessment and Instruction in Statistics Education II (GAISE II)-Book or Free Download:
  https://www.nctm.org/Store/Products/High-School-Mathematics-Lessons-to-Explore,-Understand,-and-Respond-to-Social-Injustice/

Webinars & Web Resources
- Teacher Tip Tuesday: Avoiding Data and Science Misinformation in Today's Messy Media Landscape (Open to All): https://www.nctm.org/online-learning/Webinars/Details/527
- The Practice of Statistics: YES, We Can Do It at School!: https://www.nctm.org/online-learning/Webinars/Details/371
- Digital Classroom Resources: Search for Statistics, Data, Data Science, Data Literacy: https://www.nctm.org/classroomresources/
REFERENCES & RESOURCES

Youcubed Data Science (Presenter: Jo Boaler | Contact: contact@bootstrapworld.org)
- Website: https://www.youcubed.org/
- Teacher Online Course: https://www.youcubed.org/21st-century-teaching-and-learning/
- High School Data Science Course: https://www.youcubed.org/resource/high-school-data-science-course/
- Data Science K-12 Lesson Plans: https://www.youcubed.org/data-science-lessons/
- Data Talks: https://www.youcubed.org/data-science-lessons/
- Data Big Ideas (K-10): https://www.youcubed.org/data-big-ideas/

Introduction to Data Science (Presenter: Suyen Machado | Contact: info@idsucla.org)
- Website: https://www.introdatascience.org
- Program Overview: https://www.introdatascience.org/introduction-to-data-science-curriculum
- Partnering with IDS: https://www.introdatascience.org/introduction-to-data-science-partnership
Bootstrap Data Science (Presenter: Emmanuel Schanzer | Contact: contact@bootstrapworld.org)

- Website: https://www.BootstrapWorld.org
- DS materials: https://www.bootstrapworld.org/materials/data-science/
  (Elementary grade materials are available upon request, but not yet linked publicly)
- Published research: www.BootstrapWorld.org/impact
- Work on accessibility:
  https://cs.brown.edu/~sk/Publications/Papers/Published/sbk-adap-stud-ide-blind-prog/
  https://cs.brown.edu/~sk/Publications/Papers/Published/sbk-accessible-ast-blocks/
- “4 ingredients of K12 Data Science” position paper:
  https://bootstrapworld.org/blog/curriculum/Four-Ingredients-of-Data-Science-Education.shtml
- A sneak peak at our upcoming paper on the role of Domain Investment in K12 Data Science
  https://bootstrapworld.org/blog/curriculum/Data-Science-Student-Experience.shtml
Federal Funding Resources (Presenter: Zarek Drozda | Contact: zarek.drozda@ed.gov)

- ARP ESSER Funds FAQ Guidance (May 2021): [https://oese.ed.gov/files/2021/05/ESSER.GEER_.FAQs_5.26.21_745AM_FINALb0cd6833f6f46e03ba2d97d30af953260028045f9ef3b18ea602db4b32b1d99.pdf](https://oese.ed.gov/files/2021/05/ESSER.GEER_.FAQs_5.26.21_745AM_FINALb0cd6833f6f46e03ba2d97d30af953260028045f9ef3b18ea602db4b32b1d99.pdf)
- OET Education Technology Grants Hub: [https://tech.ed.gov/funding/](https://tech.ed.gov/funding/)
- FCC E-Rate: [https://www.usac.org/e-rate/](https://www.usac.org/e-rate/)
QUESTIONS FOR ED?

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