Justice-Centered STEM Education
Using the Case of the COVID-19 Pandemic

December 2, 2021  6:00 – 7:30 pm CT
Select speaker view

» In the upper right of your Zoom window, select “Speaker View” to ensure you’ll always see the presenter’s video.
Tonight’s Agenda

**STEM and Data Science**

- How is data science reflected in math?
- How is data science reflected in science?

**Justice-Centered STEM Lessons**

» Consider ways educators can use COVID-19 data as a context to engage students in exploring societal challenges

» Explore an instructional framework which would allow educators to apply this model in their own settings
Joleigh Honey

Mathematics Equity Specialist, Utah State Board of Education

Joleigh has 27 years experience as a classroom teacher, academic coach, K-12 mathematics and building administrator and STEM coordinator. Joleigh is the current president of the Association of State Supervisors of Mathematics (ASSM) and is influential in Utah and across the country in promoting equity and increasing inclusive practices in mathematics and STEM.

@Joleighhoney
Justice-Centered STEM Education

Source: youcubed Data Science Big Ideas:
https://www.youcubed.org/data-big-ideas/
Michael Heinz

Science Coordinator, New Jersey Department of Education

Michael is a former middle and high school science teacher and the current President of the Council of State Science Supervisors (CSSS). He is deeply involved in the open-source science curriculum development, OpenSciEd, and the Advancing Coherent and Equitable Systems of Science Education (ACESSE) project, promoting equity and coherence in science education.
Overlap Between the Fields of Quantitative Reasoning and Data Science

Source: (Kjelvic & Schultheis, 2019)

Note: The numbers in the Venn diagram refer to citations included in Kjelvic & Schulthesis, 2019.


Tonight’s Presenters
Dr. Lee is a professor in the Steinhardt School of Culture, Education, and Human Development at New York University. Her research involves integrating science, language, and computational thinking with a focus on English learners. She was a member of the NGSS writing team and served as leader for the NGSS Diversity and Equity Team.
Dr. Campbell is the Department Head of Curriculum and Instruction and a Professor of Science Education in the Neag School of Education. His research focuses on cultivating imaginative and equitable representations of STEM activity. He partners with pre-service and in-service science teachers and leaders to collaboratively focus on supporting student use of modeling as an anchoring epistemic practice to reason about events in the natural world.

Todd Campbell, Ph.D.
Department Head and Professor, University of Connecticut
Tracking COVID-19 in the United States
A “Daily Do” Playlist
Purpose

• Propose our instructional framework for justice-centered STEM education to address pressing societal challenges

• Apply the instructional framework to the COVID-19 pandemic
Instructional Framework

Our instructional framework for justice-centered STEM education:

1) addresses pressing societal challenges

2) leverages convergence of multiple STEM subjects, including data science and computer science, to explain such challenges

3) centers on justice in designing solutions

Tracking COVID-19 in the United States - Daily Do Playlist
Instructional Framework

Our instructional framework for justice-centered STEM education:

1) addresses pressing societal challenges

2) leverages convergence of multiple STEM subjects, including data science and computer science, to explain such challenges

3) centers on justice in designing solutions
Science Instructional Shifts: Contemporary

Our instructional framework for justice-centered STEM education builds on and extends instructional shifts:

**Shift 1:** Phenomena or problems — Explaining phenomena or designing solutions to problems

**Shift 2:** Three-dimensional learning — Blending science and engineering practices, crosscutting concepts, and disciplinary core ideas

**Shift 3:** Coherent science learning progressions — Building science understanding across time
Knowledge of Science Disciplines

Students as Scientists and Engineers

Some Students

Traditional

Scientists & Teachers

Knowledge of Science Disciplines

Contemporary

Students as Scientists and Engineers

Making Sense of Phenomena and Designing Solutions to Problems

All Students
Science Instructional Shifts: Contemporary

Physical Science in Fifth Grade: What happens to our garbage?

Societal Challenge

“Sanitized” Phenomenon
Science Instructional Shifts: Future

**Traditional**
Scientists & Teachers

Knowledge of Science Disciplines

Some Students

**Contemporary**
Students as Scientists and Engineers

Making Sense of Phenomena and Designing Solutions to Problems

All Students

**Future**
Students as ?

All Students
Science Instructional Shifts: Future

**Traditional**
Scientists & Teachers

**Contemporary**
Students as Scientists and Engineers

**Future**
Students as ?

Images:
- Children in a classroom
- A garbage bin
- A map of the United States with red circles

Text:

The Garbage Unit
1. What are pressing societal challenges that affect our daily lives?

1. How do these pressing societal challenges disproportionately affect minoritized groups?

1. How do we design solutions to address these pressing societal challenges?

1. What is the role of STEM education?
Instructional Framework

Our instructional framework for justice-centered STEM education:

1) addresses pressing societal challenges

2) leverages convergence of multiple STEM subjects, including data science and computer science, to explain such challenges

3) centers on justice in designing solutions
Data science enables K-12 students to make sense of pressing societal challenges

**Johns Hopkins University**
Coronavirus Resource Center
[https://coronavirus.jhu.edu/map.html](https://coronavirus.jhu.edu/map.html)

**Our World in Data**
Coronavirus Pandemic (COVID-19)
[https://ourworldindata.org/coronavirus](https://ourworldindata.org/coronavirus)

**CDC Guidance**
Data Science: Global Data

Johns Hopkins Coronavirus Resource Center
Johns Hopkins University & Medicine

Global Map: https://coronavirus.jhu.edu/map.html
US Map: https://coronavirus.jhu.edu/us-map
Data Science: Data by Nation – US

Johns Hopkins Coronavirus Resource Center
Johns Hopkins University & Medicine
Global Map: https://coronavirus.jhu.edu/map.html
US Map: https://coronavirus.jhu.edu/us-map
Data Science: Data by US County

Johns Hopkins Coronavirus Resource Center
Johns Hopkins University & Medicine

Global Map: https://coronavirus.jhu.edu/map.html
US Map: https://coronavirus.jhu.edu/us-map
Data Science

*Go To The Johns Hopkins University Coronavirus Resource Center*

[https://coronavirus.jhu.edu/map.html](https://coronavirus.jhu.edu/map.html)

Interpret the global and national data.

Consider how you could use the data for your teaching.

Enter your thoughts in the chatbox.

Share your thought with the whole group (1-2 volunteers).
# CCSS for Mathematics

<table>
<thead>
<tr>
<th>Mathematical Practices</th>
<th>Mathematical Concepts</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Make sense of problems and persevere in solving them</td>
<td>K-5</td>
</tr>
<tr>
<td>2. Reason abstractly and quantitatively</td>
<td>Counting &amp; Cardinality (K)</td>
</tr>
<tr>
<td>3. Construct viable arguments and critique the reasoning of others</td>
<td>Operations &amp; Algebraic Thinking</td>
</tr>
<tr>
<td>4. Model with mathematics</td>
<td>Number &amp; Operations</td>
</tr>
<tr>
<td>5. Use appropriate tools strategically</td>
<td>Fractions (3)</td>
</tr>
<tr>
<td>6. Attend to precision</td>
<td>Measurement &amp; Data</td>
</tr>
<tr>
<td>7. Look for and make use of structure</td>
<td>Geometry</td>
</tr>
<tr>
<td>8. Look for and express regularity in repeated reasoning</td>
<td></td>
</tr>
<tr>
<td>(CCSS Math, 2010, pp. 6-8)</td>
<td></td>
</tr>
</tbody>
</table>

6-8
- Ratios & Proportional Relationships
- Number System
- Expressions & Equations
- Functions (8)
- Geometry
- Statistics & Probability

9-12
- Number & Quantity
- Algebra
- Functions
- Modeling
- Geometry
- Statistics & Probability
### Science & Engineering Practices

1. Ask questions (for science) and define problems (for engineering)
2. Develop and use models
3. Plan and carry out investigations
4. Analyze and interpret data
5. Use mathematics and computational thinking
6. Construct explanations (for science) and design solutions (for engineering)
7. Engage in argument from evidence
8. Obtain, evaluate, and communicate information

*Framework for K-12 Science Education (National Research Council, 2012)*

### Crosscutting Concepts

1. Patterns
2. Cause and effect
3. Scale, proportion and quantity
4. Systems and system models
5. Energy and matter
6. Structure and function
7. Stability and change

### Disciplinary Core Ideas

1. Physical Sciences
2. Life Sciences
3. Earth and Space Sciences
4. Engineering, Technology and Applications of Science
Cumulative confirmed COVID-19 deaths per million people

Due to limited testing and challenges in the attribution of the cause of death, confirmed deaths can be lower than the true number of deaths.

Source: Johns Hopkins University CSSE COVID-19 Data

Data Science: Data by Nation

Our World in Data “Coronavirus Pandemic (COVID-19),” by M. Roser, H. Ritchie, E. Ortiz-Ospina, and J. Hasell, 2021
https://ourworldindata.org/coronavirus
Data Science

Go to Our World in Data
https://ourworldindata.org/coronavirus

● Scroll down to “Deaths” and explore different data representations.

● Consider how you could use the data for your teaching.

● Enter your thoughts in the chatbox.

● Share your thought with the whole group (1-2 volunteers).
### COVID-19 Cases, Hospitalizations, and Deaths, by Race/Ethnicity

<table>
<thead>
<tr>
<th>Rate ratios compared to White, Non-Hispanic persons</th>
<th>American Indian or Alaska Native, Non-Hispanic persons</th>
<th>Asian, Non-Hispanic persons</th>
<th>Black or African American, Non-Hispanic persons</th>
<th>Hispanic or Latino persons</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cases</strong>¹</td>
<td>1.8x</td>
<td>0.6x</td>
<td>1.4x</td>
<td>1.7x</td>
</tr>
<tr>
<td><strong>Hospitalization</strong>²</td>
<td>4.0x</td>
<td>1.2x</td>
<td>3.7x</td>
<td>4.1x</td>
</tr>
<tr>
<td><strong>Death</strong>³</td>
<td>2.6x</td>
<td>1.1x</td>
<td>2.8x</td>
<td>2.8x</td>
</tr>
</tbody>
</table>

Race and ethnicity are risk markers for other underlying conditions that affect health, including socioeconomic status, access to health care, and exposure to the virus related to occupation, e.g., among frontline, essential, and critical infrastructure workers.

### How to Slow the Spread of COVID-19

- Wear a mask
- Stay 6 feet apart
- Wash your hands

[cdc.gov/coronavirus](https://www.cdc.gov/coronavirus)
Go to CDC Guidance

- Interpret the data in the CDC Guidance.
- Consider how you could use the data for your teaching.
- Enter your thoughts in the chatbox.
- Share your thought with the whole group (1-2 volunteers).
December 29, 2020
In the early days of the pandemic, we created a simple simulation demonstrating how social distancing can help slow the spread of the virus. It was translated into 13 languages and became the most-viewed story in the history of The Post.

*The Washington Post*
“Why Outbreaks Like Coronavirus Spread Exponentially, and How to ‘Flatten the Curve’”
https://www.washingtonpost.com/graphics/2020/world/corona-simulator/
The Washington Post
“Why Outbreaks Like Coronavirus Spread Exponentially, and How to ‘Flatten the Curve’”
https://www.washingtonpost.com/graphics/2020/world/corona-simulator/

● Consider how the computational models about social distancing relate to CDC Guidance for frontline and essential workers.

● Consider how you could use computational models for your teaching.

● Enter your thoughts in the chatbox.

● Share your thought with the whole group (1-2 volunteers).
Equity and Justice

Income Gap Between Black and White Households

The Wall Street Journal
“For African-Americans, a Painful Economic Reversal of Fortune,” by G. Ip, 2020
“The Enormous Black-White Wage Gap,” by D. Leonhardt, 2020
Income and Employment Gaps

The Wall Street Journal
“For African-Americans, a Painful Economic Reversal of Fortune,” by G. Ip, 2020

The New York Times
“The Enormous Black-White Wage Gap,” by D. Leonhardt, 2020

- Consider how you could use the data for your teaching.
- Enter your thoughts in the chatbox.
- Share your thought with the whole group (1-2 volunteers).
• Students analyze data about COVID-19 cases and deaths from
  ✔ Johns Hopkins University Coronavirus Resource Center and
  ✔ Our World in Data by Oxford University.

• Students observe racial and ethnic disparities in the data from
  the U.S. Centers for Disease Control and Prevention.
Summary:
Justice-Centered Computer Science

- Using StarLogo Nova (slnova.org), students explain underlying causes for disparities in COVID-19 cases.
  - These underlying causes include the overrepresentation of racial and ethnic minorities in crowded housing and in frontline work
  - Both causes create challenges for following CDC guidance based on STEM disciplines, e.g., keep 6 feet apart and stay at home.
- Students design solutions to promote justice in society.
Instructional Framework

Our instructional framework for justice-centered STEM education:

1) addresses pressing societal challenges

2) leverages convergence of multiple STEM subjects, including data science and computer science, to explain such challenges

3) centers on justice in designing solutions
Introduce the handout for breakout rooms

https://bit.ly/Lee-CampbellHandout

Work with your colleagues in your breakout room to discuss the questions (in red) and be prepared to share your responses.

Share your thoughts with the whole group (1-2 volunteers).
Closing Comments

Justice-Centered STEM Education
TI Education Technology is transforming the way teachers teach and students learn STEM (science, technology, engineering and mathematics) subjects.

Vince O’Connell  
Director of School Partnerships | Texas Instruments
2022 sessions begin in February

More information and registration will be available at
Thank you!