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Cultivating Critical Statistical Literacy in the Classroom

Liza Bondurant
Mississippi State University, lb2206@msstate.edu

Stephanie Somersille
Independent, ssomersille@gmail.com

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Bondurant, Liza; and Somersille, Stephanie

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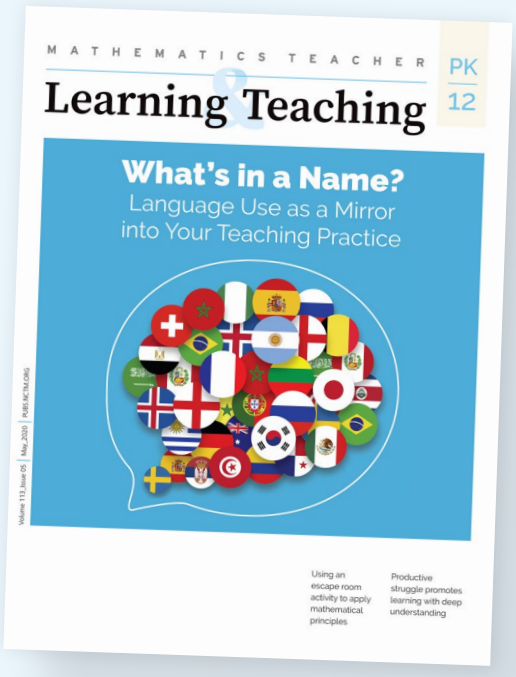

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Cultivating Critical Statistical Literacy in the Classroom

Learn about an activity and resource from *The New York Times* that can be used to help learners cultivate critical statistical literacy.

Liza Bondurant and Stephanie Somersille

Critical statistical literacy involves understanding, interpreting, and questioning statistical information to make informed decisions (Casey et al., 2023; Franklin et al., 2015; Weiland, 2017). It is a vital skill that needs to be learned and reinforced with students early and often. This can be a challenge in today's classrooms for a plethora of reasons, such as the other demands of the curriculum, the complexity of statistical concepts, and the need for mathematical proficiency. We find What's Going On in This Graph? (WGOITGraph?) (link online), a collaboration between the American Statistical Association (ASA) (link online) and *The New York Times* Learning Network (*NYT* LN) (link online), to be a useful, accessible, effective online resource. In 2023, WGOITGraph? was awarded the Best Cooperative Project Award in Statistical Literacy by the International Statistical Institute and the Institute of Advanced Studies in Education. Through these free weekly classroom resources, students have opportunities to develop their critical statistical literacy skills as they discuss their noticings and wonderings about a variety of types of graphs connected to current topics impacting their lives.

HOW *THE NEW YORK TIMES* LEARNING NETWORK WORKS

Most weeks of the academic year, the *NYT* LN shares an initial release post on Friday, live moderation of the online discussion on Wednesday, and then a concluding reveal post on Thursday. Each initial release post includes a previously published *NYT* data visualization and these same four discussion prompts:

1. What do you notice?
2. What do you wonder?
3. How does this relate to you and your community?
4. Create a catchy headline that captures the graph's main idea.

Students are invited to engage in the discussion individually, in person with peers in their classes, or asynchronously online. Based on teachers' testimonials, WGOITGraph? works best when the teacher introduces the graph during class and then provides students with class time to discuss the prompts with their peers.

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The discussion prompts are based on Annie Fetter's (2011) widely used math teaching strategy of noticing and wondering. Each student can notice something from the graph that can engage their critical thinking. Asking students how the graph relates to them and their community provokes reflection on the relevance of the graph and pushes students' critical statistical literacy development. Creating a catchy headline requires students to demonstrate their understanding of the graph and how it draws a reader into the article. Through their in-class or online discussions, students are challenged to read, respond to, and build on each other's responses. For students younger than 13, teachers are welcome to post their students' responses. Following the response box is an option for students to receive a link to their response when it appears online, allowing them and their teachers to follow their discussion. Students can share this link with their teachers (to earn credit), peers (to engage in further discussion), or family members.

On Wednesdays following Friday's graph release, high school and college-level mathematics teachers from the ASA serve as moderators, synchronously facilitating the online discussion from 9 a.m. to 2 p.m. ET. There have been more than 60 moderators from 27 states in the U.S. and 3 other countries.

Finally, on Thursday, the reveal post contains a free link to the *NYT* article that includes the graph, background information on the topic, additional follow-up questions, shout-outs to some of the most creative headlines, and Stat Nuggets. Stat Nuggets provide nontechnical definitions of the terms used in the graph and how they relate to its content.

Since 2017, hundreds of thousands of students from around the world have used WGOITGraph?. Although most are 13–18 years old, younger students, college students, and adults have participated. Most are studying mathematics, but students from science and humanities classes have participated too. The more than 170 released graphs offer teachers a treasure trove of topics, types of graphs, statistics concepts, and levels of difficulty. The 2022–23 academic year featured 23 graphs on topics ranging from the price of eggs (link online) to sex education (link online), with more than 12,500 students responding online.

EXAMPLE WGOITGRAPH?

Next, we will illustrate how to implement WGOITGraph? to promote critical statistical literacy through our use of "Climate Friendly Cars" (link online) with eighth-grade students. The article highlights the MIT Trancik Lab's carbon counter, which evaluates over 300 newly introduced car models, including SUVs and other variants, valued at $55,000 or less. We recommend sharing the interactive version (link online) with learners because it enables a customizable exploration of the data.

This graph was selected in response to struggles students had with scatter plots. The teacher thought because many students would be soon driving, they would have an interest in the impact automobiles have on the climate. The title of the graph was intentionally not shared with the students. The in-class discussion resembled the following exchange:

Teacher: What do you notice about this graph?
Vivian: It's recording four different categories of things.
Four blobs that overlap.

This student seems to be focusing on the four colors of the largest blobs: gray for traditional gas-powered cars, green for diesel cars, pink for hybrid and plug-in hybrid vehicles, and yellow for electric cars. The student overlooked the fifth category in the graph, the blue fuel cell dot (see Figure 1). However, the teacher purposefully chose not to point this out; rather, she

Liza Bondurant, she/her, began teaching mathematics in upstate New York in 2005. Since 2013, she has been a mathematics teacher educator in Mississippi and is currently an associate professor at Mississippi State University. She is passionate about helping mathematics teachers develop learning spaces where each and every learner develops an understanding and appreciation of mathematics.

Stephanie Somersille tutors math students in grades 6–12, college, and graduate school. She also does consulting work in math education and with projects involving mathematics, particularly the mathematical data science of redistricting.

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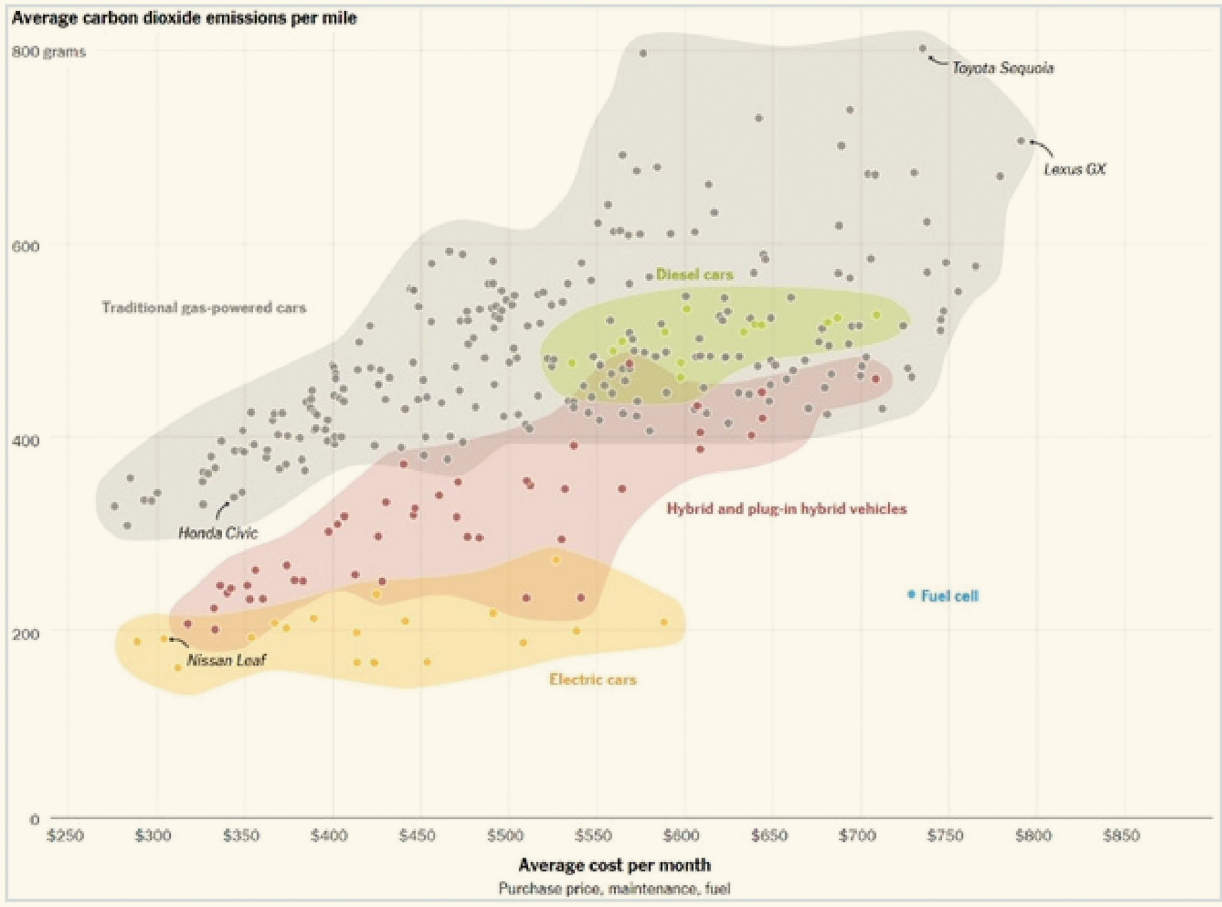
engaged the class with further clarifying follow-up questions (see the following).

Teacher: What are the four categories?
Caleb: Oh neat, it's cars!
Teacher: Okay, something about cars, what about the cars? How are they categorized?
Clark: Traditional gas-powered cars, Honda Civic, Nissan Leaf, Electric cars, Diesel cars, hybrid and plug-in hybrid vehicles, Toyota Sequoia, Lexus GX, and fuel cell.
Teacher: Hmm . . . how many categories is that?
Amya: [After a pause.] Oh, wait, the graph labeled the name of each car with a dot and the way the car is fueled with a color.
Kristi: Yes, that's it, and the colors create the blobs and the blobs kinda look like carbon emissions too!
Teacher: What do others think? Do you agree or disagree and why?
Alyssa: I agree. Look at the graph [referring to Figure 1]. Each dot has an arrow connecting the name to the dot.
Michael: Oh yeah, I see now, and the labels for the blobs are colored the same color as the blob region.
Teacher: Okay, so how many blobs are there, and what do they represent?
Kaleb: The categories are what the car runs on.
Kylie: Yeah, that's right, and as far as how many, I see gray, traditional gas-powered cars, that's one. Green, diesel cars, that's two. Pink, hybrid, and plug-in hybrid vehicles, that's three. Yellow, electric cars, that's four. So, there are four.
Teacher: Do y'all agree or disagree? Four categories?
Cameron: What about that blue dot that says fuel cell?
Natalie: Oh yeah! So, five categories.

Figure 1 Graph From the *NYT* Article



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In the previous exchange, students showed interest in the context of the graph. They initially confused the individual dots, which each represent the make and model of a vehicle, with the "blobs," which are used to categorize the way the vehicle is fueled. This explained why students had different and inaccurate numbers of categories of vehicles earlier in the exchange.

Teacher: What do you wonder?
Madelyn: I wonder about the overlapping regions. Is it like those circles that overlap? Does that mean vehicles can run on more than one thing?
Teacher: A Venn diagram?
Grace: Yeah, the overlap means different types of vehicles are kind of the same.
Teacher: Do you know what diesel is?
Caleb: Not really [This gave us an opportunity to talk about what diesel fuel is.]
Amya: Oh, so diesel is a type of gas . . . but not gas. It's like a different thing.
Teacher: Yes. A different type of fuel.

The above exchange demonstrates how the graph can inspire students to make connections. Students drew connections to Venn diagrams and various sources of energy.

Teacher: What else do you wonder about?
Kasey: Why the blobs are where they are?
Teacher: Can you say more? What do you mean?
Kasey: Like, the electric blob is smaller than the hybrid blob and the gas blob.
Teacher: Okay. What do you mean by "smaller"?
Cameron: I think she means lower. Lower cost. They're actually cheaper to drive than hybrid and gas cars, woah!
Teacher: That's true . . . so what helped you to notice that electric cars are less expensive?
Cameron: The x-axis. It shows how much the car costs.
Michael: Hey, check out the y-axis too. That's like how harmful the car is to the planet.
Vivian: Oh, okay. Wait . . . so cars that run on gas are more expensive *and* are the most harmful to the planet . . . seriously?
Teacher: Did you know that?
Kylie: I knew they weren't good, but I never saw it like this.
Teacher: How does this relate to you and your community?
Madelyn: There are a lot of electric cars around here. So that's good.
Kristi: It may seem like a lot, but look at the graph . . . there are a lot more cars that run on gas.
Alyssa: True, true . . . the gas blob totally has the most dots.
Kasey: So, there are more gas-powered cars than the other types.
Clark: But maybe they didn't list every single car.
Alyssa: True . . . but they listed a ton of them.
Amya: Yeah, and the values of cost and emissions are more spread out for the gas cars.

In this exchange, students used their communication skills to demonstrate their solid grasp of statistical concepts and skillful application of statistical reasoning to real-world scenarios.

Teacher: Can you come up with a catchy headline for this graph?
Grace: Types of cars, their carbon emissions, and costs.
Natalie: I like that, but it sounds more like a title for a report. We want something catchy . . . how could we blow it up on social [media]?
Madelyn: I have over 1 K followers . . . I know there are tons of people who want to save the planet. We should call it "How electric cars are better for the planet."
Teacher: I like that. What else are they better for according to the graph?
Caleb: Oh yeah, duh . . . they are cheaper too!
Teacher: Okay, so let's put it together—what we learned from the x-axis and the y-axis.
Amya: Electric cars are better for the planet and your wallet!
Kylie: Love it!

The open-ended discussion prompts created an environment in which all students could participate. Students often ignore the labels on the axes of the graphs, but here, their curiosity led them to search out the information on the axes without being prompted. In crafting catchy headlines, students synthesized what they learned: that there is a direct relationship between car costs and emissions. As Amya stated, "Electric cars are better for the planet and your wallet!"

CONCLUSION

In this article, we have demonstrated how teachers can address statistical literacy using WGOITGraph? and shared an example implementation. Through

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online discussion, students get to discuss the graphs with people from around the world. Moreover, the graphs are like a puzzle, so students are absorbed in figuring out the story and uncovering surprises that could change their thinking about a topic. Because the graphs engage with current topics in which students have an interest, they feel empowered by opportunities to explore and reason about unique types of graphs on topics connected to their everyday lived experiences.

Finally, students can cultivate their critical statistical literacy by investigating, scrutinizing, deciphering, and evaluating distinctive graph formats associated with significant subjects. Developing critical statistical literacy empowers students to become informed citizens. It enables students to navigate the increasingly data-driven world, recognize potential biases and misleading interpretations, and make sound judgments based on statistical evidence.

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