Slow Reveal Graphs:
A Powerful Instructional Routine
by Tim Berrigan

Tim Berrigan is an educator, poet, and part-time astrologer. He currently serves as the Site Manager at Brooklyn Public Library's New Lots Adult Learning Center. In his previous role at Brooklyn Public Library, he taught ABE and HSE classes and facilitated best practices professional development sessions for adult education instructors. He recently became a New York State Teacher Leader in Mathematics and is the recipient of a NYSED/CUNY mini-grant, which he used to create a collection of slow reveal graphs that include suggested questions, extensions, and further reading.

In their book, *Routines for Reasoning: Fostering the Mathematical Practices in All Students*, Kelemanik, Lucenta and Creighton explain: "Instructional routines are specific and repeatable designs for learning that support both the teacher and students in the classroom" (Kelemanik et al., 2016). Consistent classroom routines in line with best pedagogical practices, support and enable both students and teachers to do their best thinking, wondering, and sense-making. In this article, we will discuss the instructional routine of Slow Reveal Graphs.

Slow Reveal Graphs are a sense-making instructional routine that slowly unfolds crucial elements of a graph sequentially. This scaffolded approach allows teachers and students to:

- **slow down**
- **ask questions**
- **make observations**
- **formulate hypotheses**
- **make predictions**
- **analyze changes**
- **evaluate and reflect**

Slow Reveal Graphs can blur the distinctions regarding what a reading, social studies, science, or math class looks like. We want students to engage with thinking and being in their entire world, not only in the classes and subjects in which they feel comfortable. Students can be quick to shut down when faced with ELA or Math content when it creeps up across the curriculum. Perhaps you have had your students say something like:

- "Why are we doing math right now? This is GED Social Studies Class."
- " I don't need to study Social Studies. I only need to pass the GED math test!"

I am not sure those exact words have ever been spoken, but I *am* sure many sentences quite close to them have.

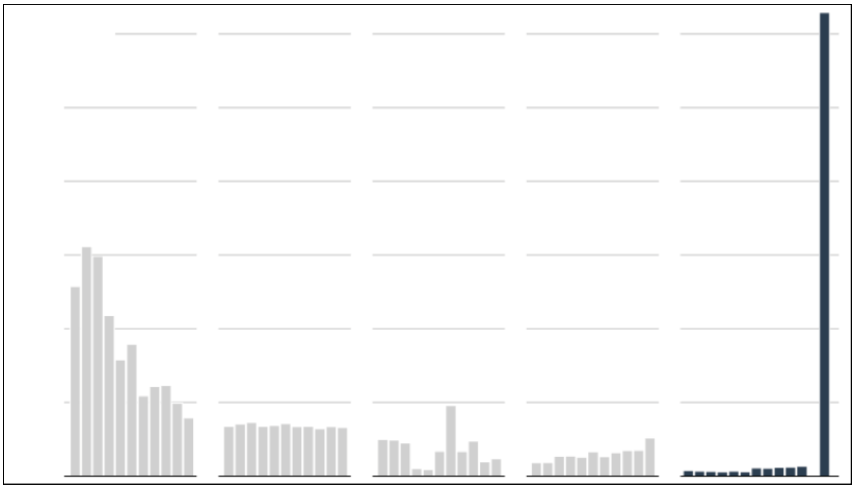
A cursory glance over the GED subject tests will reveal statistics, numeracy, and mathematical thinking on both the Social Studies and Science test. Creating a space for thinking that spans the Math/ELA divide, especially with the limited timeframes available to instructors and students in adult education programs, is crucial for student and teacher success. In this article, I will focus on three specific qualities that slow reveal graphs support in sensemaking and thinking: a) Slowing Down**,** b) Mistake Making: Productive Struggle (with a safety net)**,** and c) Critical Reflection.

Slowing Down

Graphs, charts, and tables are complicated. Graphics come in many genres, such as infographics, bar graphs, line graphs, pie charts, and scatter plots–each presenting information and ideas in their own specific ways. Often, graphics require readers to have some familiarity with their form. The way one reads and approaches one graphic may be entirely ill-suited for reading and approaching another. Additionally, due to the multi-layered nature of graphics, students often feel overwhelmed when presented with complex graphs. This can lead students to rush to incorrect judgments and conclusions rather than slowly working through the graph's many layers.

Often, when an entire graph is given to students, the instructor resorts to developing a line of inquiry for the whole class to follow. This approach, even unintentionally, calls to mind one of Paulo Freire's Banking Education Maxims,[1] "the teacher thinks and the students are thought about (Freire, 1960)." The slow reveal instruction routine allows classroom lines of inquiry to be driven by student observation, analysis, and questioning. Each image in a Slow Reveal sequence can be accompanied by a few questions designed to prompt student thinking and wondering; the prompts are low floor/high ceiling questions designed to support and guide student thinking but not to direct it. The following sequence of images slowly reveals a graph. Take the time to experience each aspect of the graph, by looking at only one image at a time and answering the questions that accompany each image before moving on to the next image.

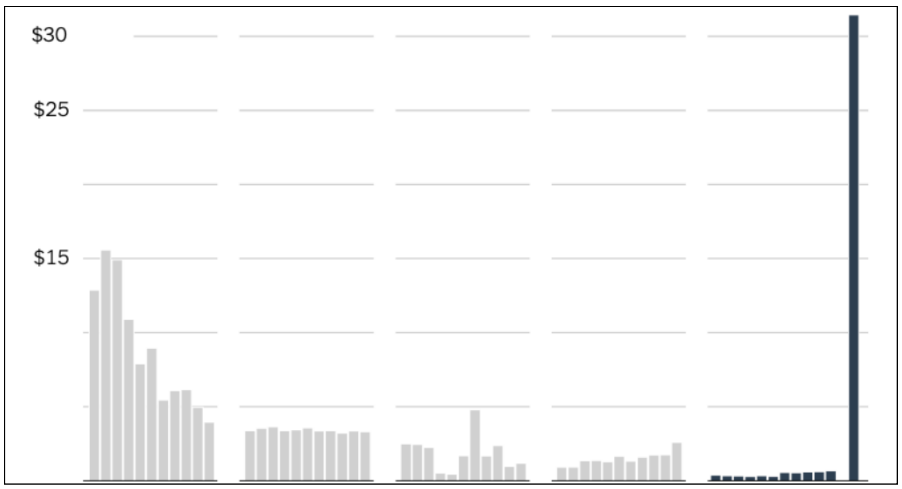
Image 1



What do you notice? What do you wonder?

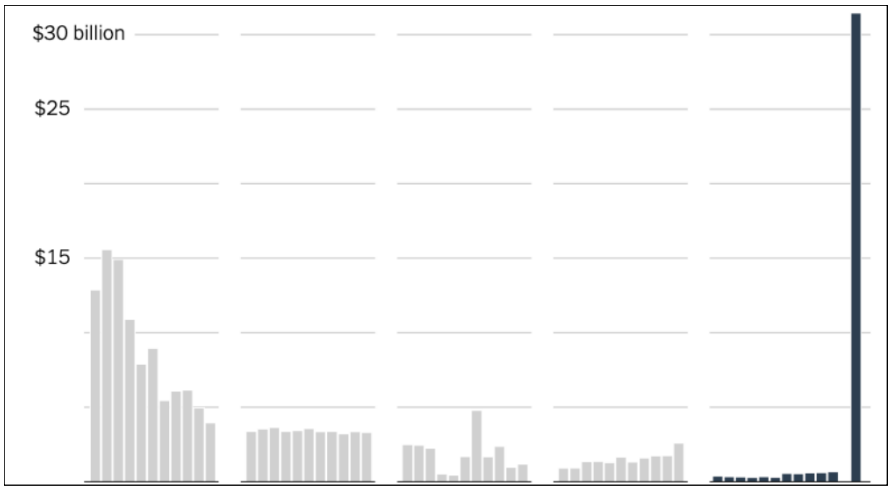
[1]In Freire's words, Banking Education is an "act of depositing, in which the students are the depositories and the teacher is the depositor."

Image 2



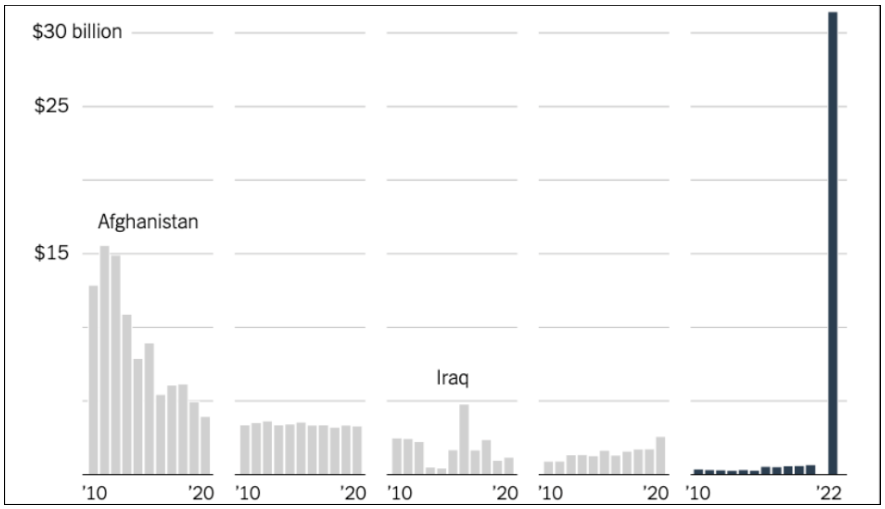
What information did we learn? What missing values could we estimate on the left side?

Image 3



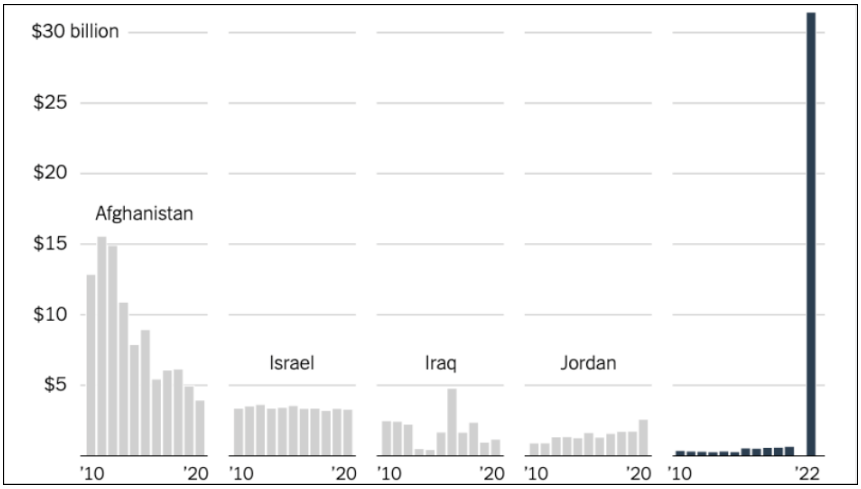
What new information did we learn? What changed? How were our estimations? What new estimations can we make?

Image 4



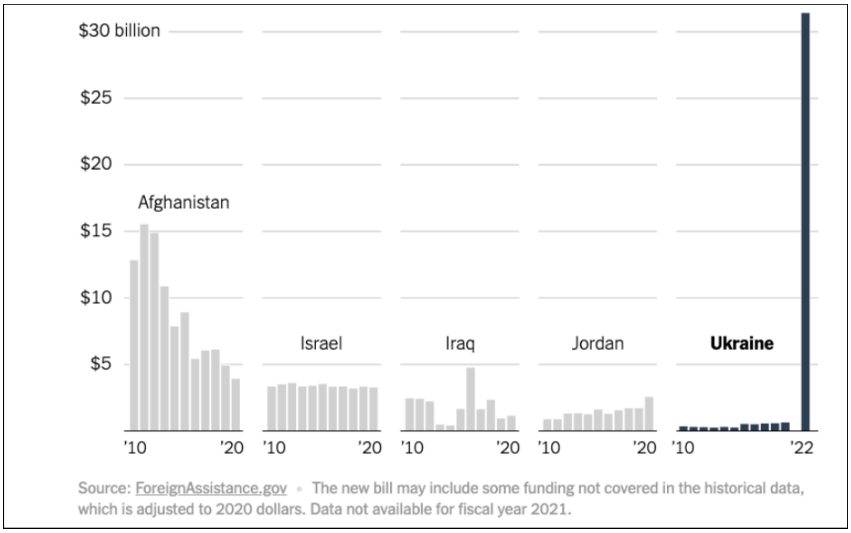
What new information did we learn? What changed? Which section has the highest average bar height? What do you notice about the values at the bottom?

Image 5



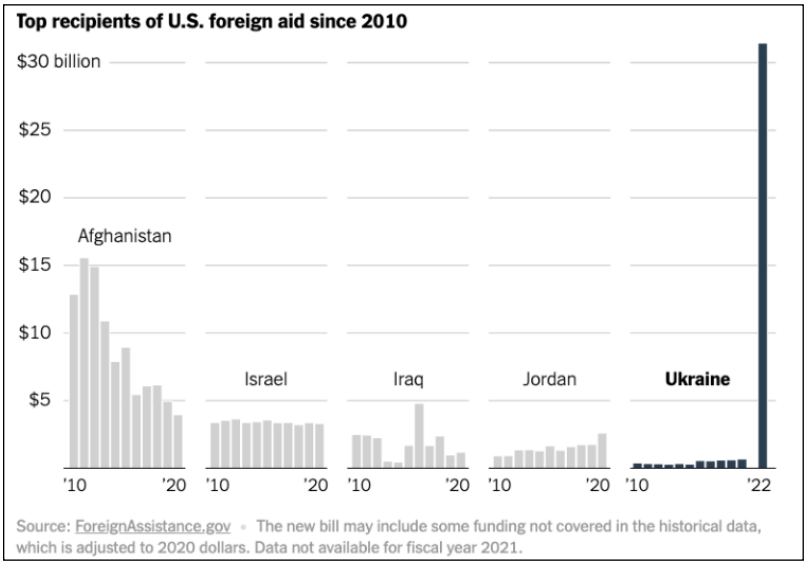
What new information did we learn? Which country has the highest average bar height? What do you think this graph might be about?

Image 6



What do you think the title of this graph is? What would you name it? Why?

Image 7



(The graph with all the layers added back in.)

What was that experience like for you? What changed when we slowed down the process and allowed time and space for each iteration of the graph? How was that experience different than working with the graph all at once? What happens when we break larger tasks down into smaller tasks? What do you imagine this experience would be like for students? What does a slow reveal graph make possible that may not have been otherwise? What may be challenging for students? How can you imagine working with a slow reveal graph in your class? What would you reveal differently with this graph? Why? Which questions would you ask? Which questions wouldn't you ask?

Mistake Making and Productive Struggle (with a safety net)

Jean Anyon (1980), in her article "Social Class and the Hidden Curriculum of Work", observes that instead of critical thought and sense-making, often, "[school] work is getting the right answer. If one accumulates enough right answers one gets a good grade". The spirit of this statement is still very much alive 40 years later in our classrooms. Culturally, we think of mistakes as signs of error or, worse, incompetence. If we get answers wrong, we fail. More specifically, in my experience, students in adult education classes take mistakes more personally—they have likely experienced challenging educational experience in their past, with particular emphasis on the right or wrong dichotomy.

Students can begin to identify themselves with their mistakes or miscues; they are their mistakes and their mistakes are them. However, we know mistakes are not antithetical to learning and intelligence–they are indicators of both. Research reveals that mistakes are the tentpoles of learning and thinking. Carol Dweck argues, "Every time a student makes a mistake in math, they grow a synapse". Jo Boaler advises, "One of the most powerful moves a teacher or parent can make is in changing the messages they give about mistakes and wrong answers in mathematics" (Boaler 2016). To that end, at youcubed.org, Boaler mentions a sign from one of her summer math camps that read:

In this class, mistakes are:

- ***expected***
- ***respected***
- ***inspected***

Instructors can tell their students that mistakes are great, that students are free to make as many mistakes as they want, that mistakes are valued and encouraged, that mistakes are part of the learning process, and so on. However, many students still do not feel comfortable making mistakes. Much of their experience and mental, cultural, and emotional hardwiring tells them the exact opposite–that mistakes are a bad thing –especially in school environments.

However, instructional routines, like the slow reveal graphs, create structured, well supported, mistake-inevitable learning environments. Over time, students begin to feel comfortable being wrong and trying different problem solving approaches. What I mean by mistake-inevitable is that by removing almost all of the essential information of a graph, and by asking students to observe, analyze, and make conjectures,

errors or mistakes are inevitably going to happen. Students begin to see mistakes, misreadings, and errors as inherent to the process.

Of course, this doesn't happen all at once, but that is where the functionality of an instructional routine enters the chat. Over time, week after week, students become more accustomed to the routine and feel less anxious about making incorrect observations or predictions. When students feel less and less anxious, they are more willing to try to make conjectures and predictions without the fear of being wrong or identified with their error.

For example, if on **Image 2**, one "correctly" thinks the y-axis is representing five-dollar intervals going up to $30, but then the student's Wonka-esque teacher reveals that the y-axis is actually representing five-billion dollar intervals going up to $30 billion, students could feel distance from that mistake. The misinterpretation wasn't their fault, but due to the way in which the graph was presented. The error doesn't define the student because they weren't given access to the necessary prerequisite information to arrive at the right answer.

This is what I mean by productive struggle with a safety net. We know as instructors, learners, and humans that struggle is not always a pleasant feeling, so finding ways to make struggle *productive* can be difficult and challenging for instructors and learners. Of course, supportive and well-scaffolded teaching, like Slow Reveal graphs, can ensure that struggle in the classroom is productive. They reveal to students that mistakes are inevitable in, and inherent to, the sense-making process—mistakes are instructive and informative to thought, analysis, and inquiry. We are not defined by our mistakes; we utilize our mistakes to revise, edit, adjust, and advance our thinking.

Critical Reflection

Working off the example regarding the y-axis scale, we know that when students feel comfortable making mistakes, they are more likely to take risks and engage in productive struggle. Further, during this process, students are frequently engaged in metacognitive opportunities with each additional image in the slow reveal sequence. The questions in each image prompt students to ask themselves, "What has changed from **Image 2** to **Image 3**?"or "What is this graph about?". Thus, while acclimating students to mistake making, we are also providing them opportunities to reflect upon what they know now, and what they could not have known just one image earlier.

College Composition and Rhetoric Scholars, Liane Robertson, Kara Taczak, and Kathleen Blake Yancey, refer to these moments as "critical incidents". When we expose our students to what I would call high frequency critical incident activities, we allow for the time, space, and opportunity for students to create "new knowledge and practices for themselves when students encounter what we call a setback or critical incident, which is a failed effort to address a new task that prompts new ways of thinking" (Robertson et al, 2012).

Much of literacy instruction is familiar with pre, during, and post activities. For slow reveal graphs, a powerful summative exercise is sentence starters. Sentence starters help students to critically reflect upon both the graph content itself and the student's experience of working through the graph, further solidifying that mistake-making is productive.

Below, I have included a few sentence starters that direct student thinking toward the meta-reflective:

- When I first looked at this graph, I thought _____.
- One thing about the graph that was easy for me was _____.
- One thing about the graph that was challenging for me was _____.
- I was really lost when _____.
- Once I understood _____, I felt _____.
- The most important piece of information on this graph is _____.
- Next time when working with graph, I'll make sure to _____.

As Robertson et al (2012) argues, new tasks will promote new ways of thinking for students; instructional routine extensions, like sentence starters, encourage students to reflect upon their experience while grappling with the new demands of a new task, promoting the necessary metacognition to develop new approaches and strategies for sensemaking when working with graphics and complex texts. For example, a student may reflect upon how the entire content or meaning of the graph changed when the y-axis shifted from representing single dollars to billions of dollars.

Sentence starters, linked to the slow reveal instructional routine, helps students reflect on the content and numeracy tasks they are facing. They also prompt the student to think about their strategies when approaching graphic texts. Instructors might utilize very specific metacognitive reflective prompts or allow the experience to be more of a reflection journal experience. Either way, this further emphasizes the value of mistake-making, and the value of inspecting and respecting mistakes as a form of productive struggle during sense-making activities.

Final Thoughts

I encourage you, regardless of what subject or level you teach, to introduce the Slow Reveal Instructional Routine into your classrooms. As with any routine, familiarity and comfort develop over time; however, I believe you will see an increase in student inquiry, sense-making, and reflection at the onset. Through consistent work with this instructional routine, we increase access and comfort with complex graphic tasks without sacrificing rigor and student autonomy. We don't do the thinking for the students—if anything, rigor and autonomy are increased by the freedom and support the instructional routine provides.

Rather than telling students that mistakes are integral to the learning process, slow reveal graphs demonstrate the value of mistake-making to students through their lived experiences. This will likely eclipse what instructors have to say. Through sentence starters and reflective activities, students reflect on the GED-subject content and graphic information and also begin to reflect on their own thinking and processes when working with graphs; slow reveal graphs help students think about their own thinking in productive ways.

Critical reflection, investigating what worked and what did not, provides students space and opportunity to prioritize and vary sense-making approaches depending on the task at hand. There isn't a single approach

that will always prove effective and fruitful when working with complex visuals and graphs. Our approach should be dependent upon the given task and graphic. Prescriptive pedagogy too often provides single or limited pathways for students to utilize when in class or test-taking. Slow reveal graphs help students experience and utilize varied approaches in order to make meaning within the specific moment they find themselves working. These are the habits of mind we should strive to support and develop in our students.

References:

Anyon, J. (1980). Social class and the hidden curriculum of work. *Journal of Education,* 162(1), 67–92. https://doi.org/10.1177/002205748016200106

Boaler, J. (2015). *Mathematical mindsets.* John Wiley and Sons, Inc. https://www.amazon.com/Mathematical-Mindsets-Unleashing-Potential-Innovative/dp/0470894520

Freire, P. (1960). *Pedagogy of the oppressed.* Continuum. https://envs.ucsc.edu/internships/internship-readings/freire-pedagogy-of-the-oppressed.pdf

Kelemanik, G., Lucenta, A., Creighton, S. J., & Lampert, M. (2016). *Routines for reasoning: Fostering the mathematical practices in all students.* Heinemann. https://www.heinemann.com/products/e07815.aspx

Robertson L., Taczak K., & Yancey K. (Fall 2012). *Notes toward A Theory of Prior Knowledge and Its Role in College Composers' Transfer of Knowledge and Practice.* Composition Forum 26 (Fall 2012) https://compositionforum.com/issue/26/prior-knowledge-transfer.php

From the Editor:

Ready to Get Started with Slow Reveal Graphs?

CollectEdNY	slow reveal Graphs
Browse the collection at CollectEdNY. Here you will find a link to a Google folder full of slow-reveal graphs and sense-making questions focusing on specific GED Social Studies and Science skills. For each graph you will find prepared slides with a slow reveal progression and suggested sense-making questions for each layer of the reveal.	SlowRevealGraphs.com is a collection of slow reveal graph sequences organized by type of graph as well as by context. Each graph has at least one paired text – often a newspaper article – that goes along with the content of the graph. The site is curated by Jenna Laib, a math specialist in Massachusetts.

Try out a slow reveal graph from one of the collections noted above and let us know how it played out in your classroom. We'd love to share your experience in a future issue of *The Math Practitioner*.
Contact Patricia Helmuth, Editor, with your submission: mathpractitioner@gmail.com