



Leveraging Reflective Readings to Support Coherence in an IBME Math for Liberal Arts Course



Elizabeth Thoren
Pepperdine University
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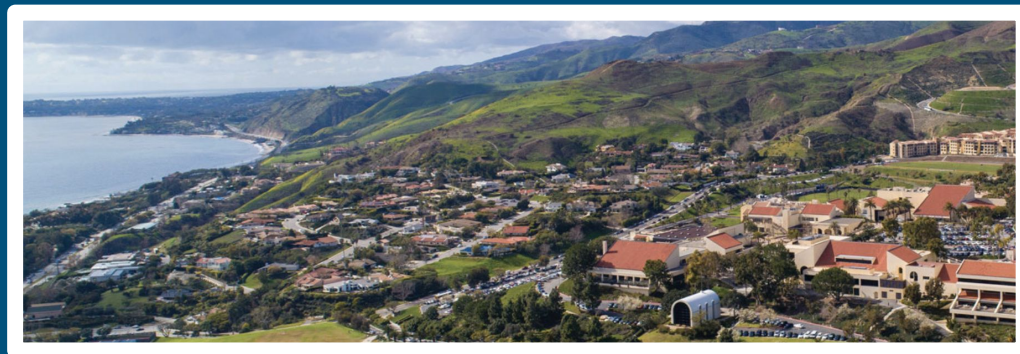


Outline

- The Context
- The Challenge
- The Response: WMDs

All peppered with some general information on how I think about integrating reflections on readings/videos into my class.

Context



- Pepperdine University
- Nature of Mathematics
 - GE course, non-STEM majors
 - 15-20 students

Central to ALL of my Teaching:

Our job as educators is to support *our students* in moving the mathematics forward.

What do I mean by IBME?

Inquiry-Based Mathematics Education is a merging of two major strands of inquiry in US higher education: Inquiry-Oriented Instruction (IOI) and Inquiry-Based Learning (IBL). (Laursen & Rasmussen).

It's characterized by the 4 Pillars of IBME:

1. Students engage deeply with coherent and meaningful mathematical tasks.
2. Students collaboratively process mathematical ideas.
3. Instructors inquire into and leverage student thinking.
4. Instructors foster equity in their design and facilitation choices.

Four Rehumanizing Pillars of IBME

This framework enriches the 4 Pillars of IBME (from Brian Katz & Jess Ellis Hagman):

- **Students should engage mathematics deeply and experience it as a living discipline.** That mathematics should be driven by questions that make sense and are valuable from students' perspectives and should allow them to create mathematics that is at least new to them.
- **Students should collaborate, developing their own authority and collective ownership of the mathematics,** engaging their full selves and bodies and learning about themselves and their peers through these interactions.
- **Instructors should leverage students' thinking to broaden mathematics and deepen the community discourse.**
- **Instructors should attend to positioning each student as a knower and person who is represented in mathematics and should actively resist historical and ongoing oppressive hierarchical systems.**

Context

A goal of our Math for Liberals Arts course at Pepperdine is to share the beauty of mathematics.

However, the students enrolled in this course have typically experienced mathematics as boring and irrelevant to their lives or, in worse cases, traumatizing.

Nature of Mathematics: Course Goals

Big Question: How can mathematics enrich your life and work?

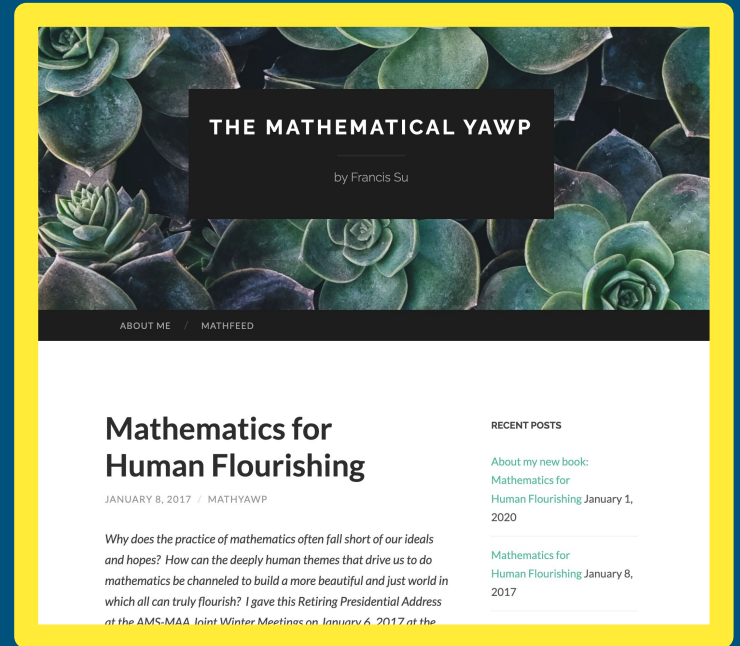
(SLOs): Students who complete this course should be able to,

- provide examples that illustrate the beauty, creativity, and pervasiveness of mathematics.
- demonstrate logical reasoning ability and problem-solving skills that employ mathematical strategies.
- **demonstrate an understanding of the creation, use, and limitations of mathematical or statistical models.**

MFHF as Framework for NoM

Mathematics for Human Flourishing as a framework for the course.

- **Play:** SET Conjectures, Counting Problems
- **Beauty:** Counting Patterns, Pythagorean Theorem
- **Truth:** Pythagorean Theorem, Logic, Toulmin Analysis, Factors Conjectures
- **Justice:** Voting Theory, Gerrymandering, Probability??
- **Love:** *They're not always seeing it...*



Reflections in NoM

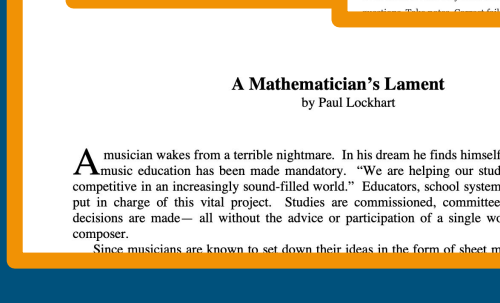
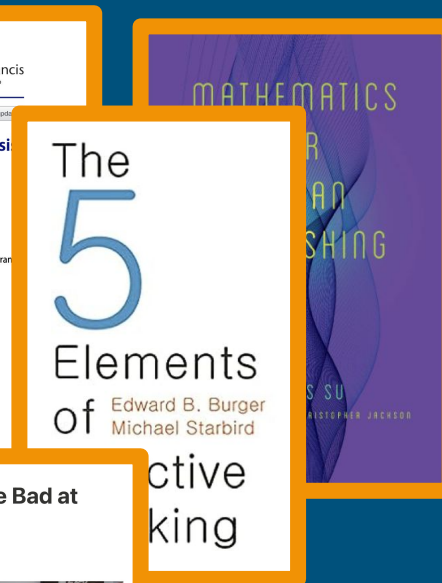
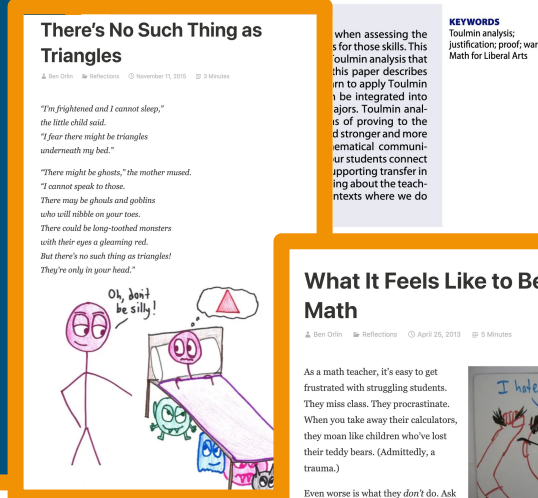
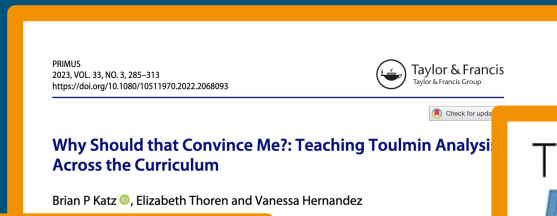
Positive experiences with mathematical inquiry can do a great deal to shift students' attitudes about doing mathematics.

And integrating reflective readings to support these inquiry experiences can pivot this shift towards a richer understanding of mathematics as a discipline and the positive role it can play in their lives.

Reflections in NoM

Students write a Reflection Essay every week:

- “A Mathematician’s Lament”
- *5 Elements of Effective Thinking*
- Math With Bad Drawings
- *Why Should that Convince Me? Teaching Toulmin Analysis Across the Curriculum*
- Math for Informed Citizens
- Mathematics for Human Flourishing



The Challenge

How to more meaningfully explore the creation, use, and limitations of mathematical models in a way that helps students understand how mathematics can enrich their lives and work while also positioning each student as a knower and person who is represented in mathematics AND actively resisting historical and ongoing oppressive hierarchical systems?



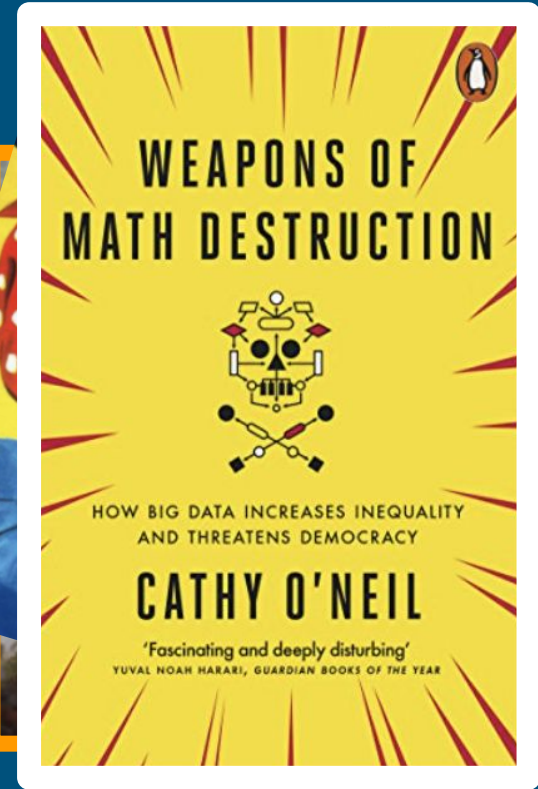
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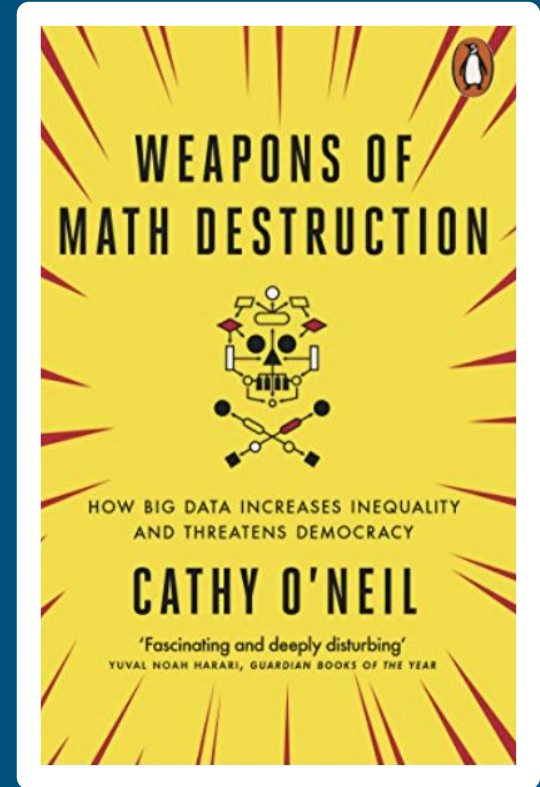
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The Response!

Big ideas from WMDs to explore:

- Chapter 1 - Bomb Parts: What is a model?
- Chapter 3 - Arms Race: Going to college.
- Chapter 5 - Civilian Casualties: Justice in the age of big data.
- Chapter 6 - Ineligible to Serve: Getting a job.

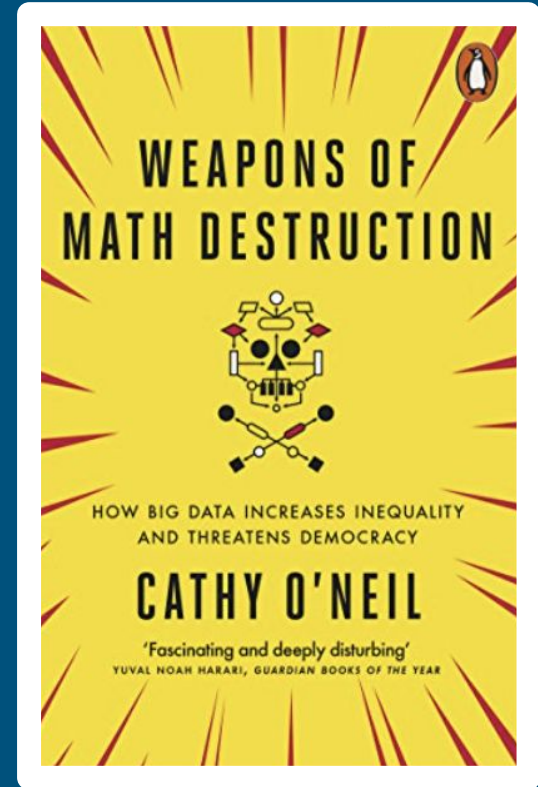


Integration

O'Neil defines a model quite broadly: “an abstract representation of some process” (p 18).

This opened the door for many different examples:

- Penny Packing
- Voting Theory
- Grading Schemes
- Probability ✓



The Reflection Assignment

Standard format for writing a reflection assignment:
(Explain/Compare/Connect)

- (Explain) Have students explain some idea from the reading in their own words.
- (Compare) Have students compare the ideas from the reading to their own experiences.
- (Connect) Have students connect ideas from the reading to our work for the course.

The Reflection Assignment (pt 1)

For this week's reflection you will read a chapter from Cathy O'Neil's book *Weapons of Math Destruction: How Big Data Increases Inequality and Threatens Democracy*. In the chapter "Bomb Parts", O'Neil defines a model, gives some examples, and describes some properties that make a model or algorithm a WMD.

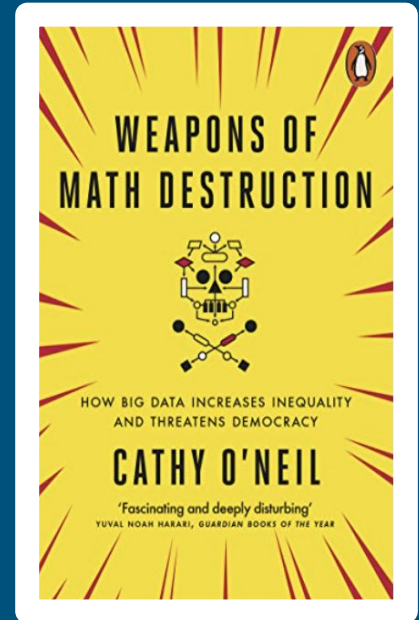
1. O'Neil defines a model very broadly as "an abstract representation of some process" (p18). Explain what O'Neil means here by giving an example of a model that illustrates the idea. Your example can be from the chapter, from our class, or from your own experiences. Describe the process this example model is representing as well as the inputs and outputs of the model.

2. O'Neil brings up 3 big questions we can ask to help us determine if a model might be a WMD:

- Is the model opaque, or even invisible?
- Does the model work against the subjects interest? Does it damage or destroy lives?
- Does the model have the capacity to grow exponentially? Does it scale?

Respond to each of these three questions for the example model you wrote about for part 1.

3. Lots of vocabulary comes up in the chapter that is worth clarifying. e.g. What does O'Neil mean by a "proxy"? If there are other words that are new to you, share them along with your best interpretation of their meaning and any questions that come up.



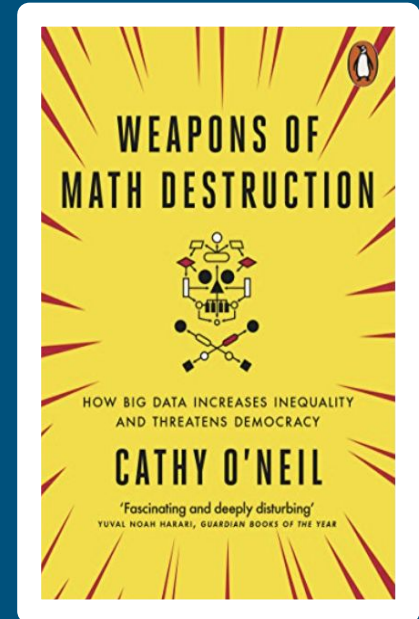
The Reflection Assignment (pt 2)

For this week's reflection you will read another chapter from Cathy O'Neil's book *Weapons of Math Destruction: How Big Data Increases Inequality and Threatens Democracy*. This time you will choose ONE of the chapters listed below to read and analyze -- each describes a different model, or WMD, and outlines the features of the model that lead to harm.

- Chapter 3 - Arms Race: Going to College.
- Chapter 5 - Civilian Casualties: Justice in the Age of Big Data.
- Chapter 6 - Ineligible to Serve: Getting a Job.

For the chapter you choose:

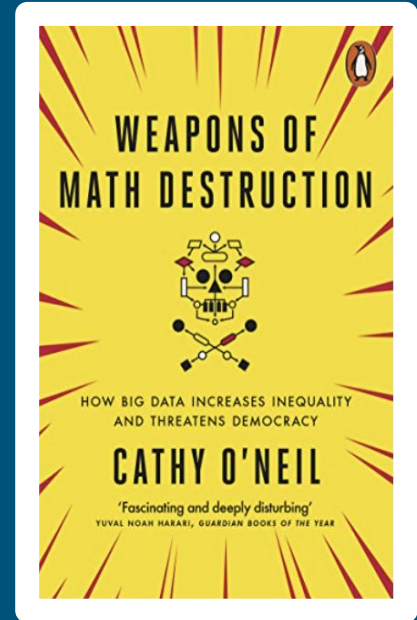
1. Give a summary of at least one of the WMDs described in the chapter. Be sure to give enough detail to demonstrate what this WMD is modeling, what kinds of information (or proxy data) go into the model, who is harmed by the model and in what way, and what feature of the model leads to this harm.
2. Identify two significant Claims from the chapter you choose and give a Toulmin analysis of those Claims (i.e. identify the Data and Warrant for each Claim). I've given an example of two Claims from Chapter 1 (the chapter from our last reflection) of WMDs below to give you a sense of what I'm asking you to do.



The Discussion

Standard Discussion Format:

- Give students 5-7 minutes to share ideas from their essays in small groups.
- Have each group choose a spokesperson to share out one or two big ideas from small group discussion.
- If there are several readings – one “expert” on each reading in each group.
- See where it goes. Highlight and inject ideas if needed, but let them do the talking as much as possible.

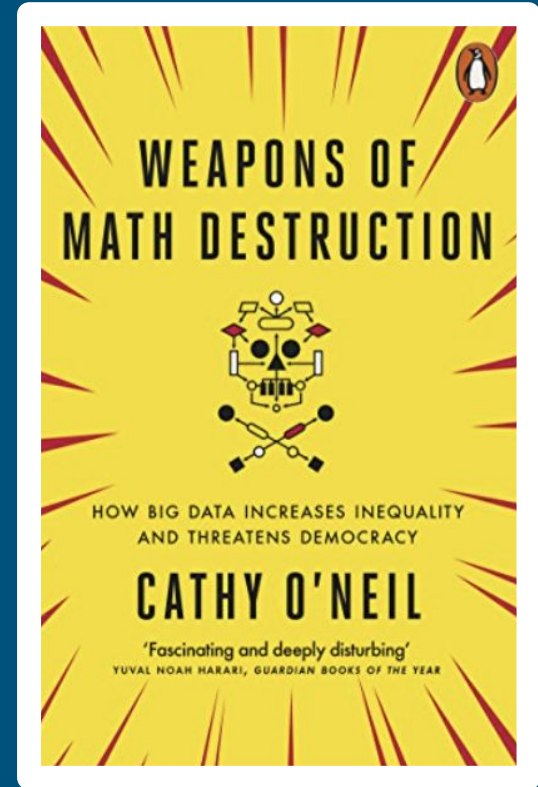


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Response

90% of students *agree* or *strongly agree*

“The overall class experience has contributed to the development of my sense of personal values and moral integrity.”

WMDs provides framework for Probability

Modeling the Future: Probability

We can use mathematical ideas to predict the likelihood of an event occurring – i.e. the *probability* of an event occurring.

Today we're going to explore **two different probability models**:

The first, **experimental probability**, is based on the assumption that things will continue as they have in the past and leverages empirical data to determine the likelihood of an event occurring.

The other, **theoretical probability**, starts with different basic assumptions – some outcomes are equally likely – and stretches them to their logical conclusion through deductive reasoning.

Inputs: outcome counts

Outputs: a percentage that indicates the likelihood of an event occurring.

Keep Growing

- Give room for students to compare the ideas from the reading to their personal experiences? Windows/Mirrors.
- Balance the painful social justice ideas with more affirming examples.

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Thank you!

Questions? Thoughts?

elizabeth.thoren@pepperdine.edu