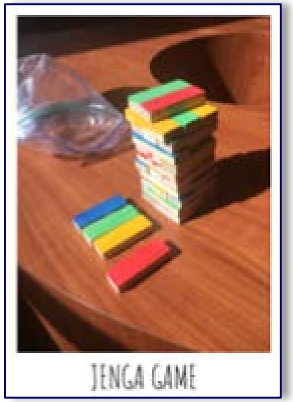
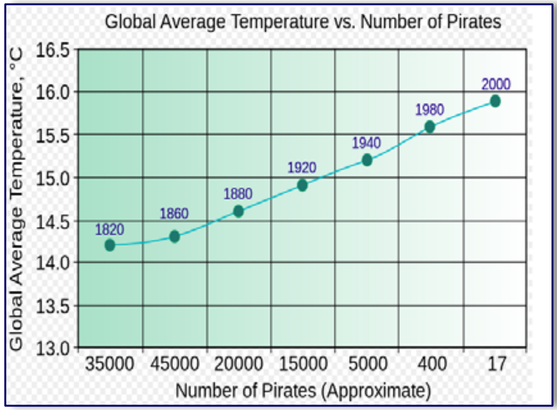




Supporting Dispositional Growth for Math (and Science) Teaching in a Methods Course

Lisa Marco-Bujosa
Villanova University
SSMA Annual Conference 2019
Salt Lake City, UT
November 8, 2019

Problem

- National math and science education frameworks represent a “practice turn” and emphasize students “figuring out” rather than “learning about” (e.g. Common Core Math, NGSS)

- Math and science teachers tend to emphasize facts and procedural knowledge over problem-solving and critical thinking (Berland et al., 2016; Selling, 2016)
  - This orientation is strongly influenced by their own experience as learners

Problem

- Supporting pre-service teachers' dispositions, or mindsets and beliefs about students, teaching, and learning is one way to foster professional growth in teacher education (Bialka, 2016)

- Little research has examined the development of content-based dispositions as a way to support practice-based math and science teaching.

Research Questions

1. *How do pre-service teachers' dispositions towards math teaching change in the context of a math and science methods course?*
   - *What aspects of the methods course supported these dispositional shifts?*

2. *How do these dispositional changes relate to instructional priorities and design choices?*

Theoretical Framework: Math Teaching Dispositions

- Adapted from Bialka, 2016 & Gresalfi, 2009

Category	Code	Examples
Dispositions	… toward ***teaching***	• Structures for learning (group, individual) • Viewing teaching as a process of building knowledge
	…toward ***math***	• Distribution of authority (who does math?) • Mathematics as a social practice vs. "math is math"
	… toward ***social justice***	• Respect for students' identities • Dedication to equity • Social and cultural relevance

Math and Science Methods

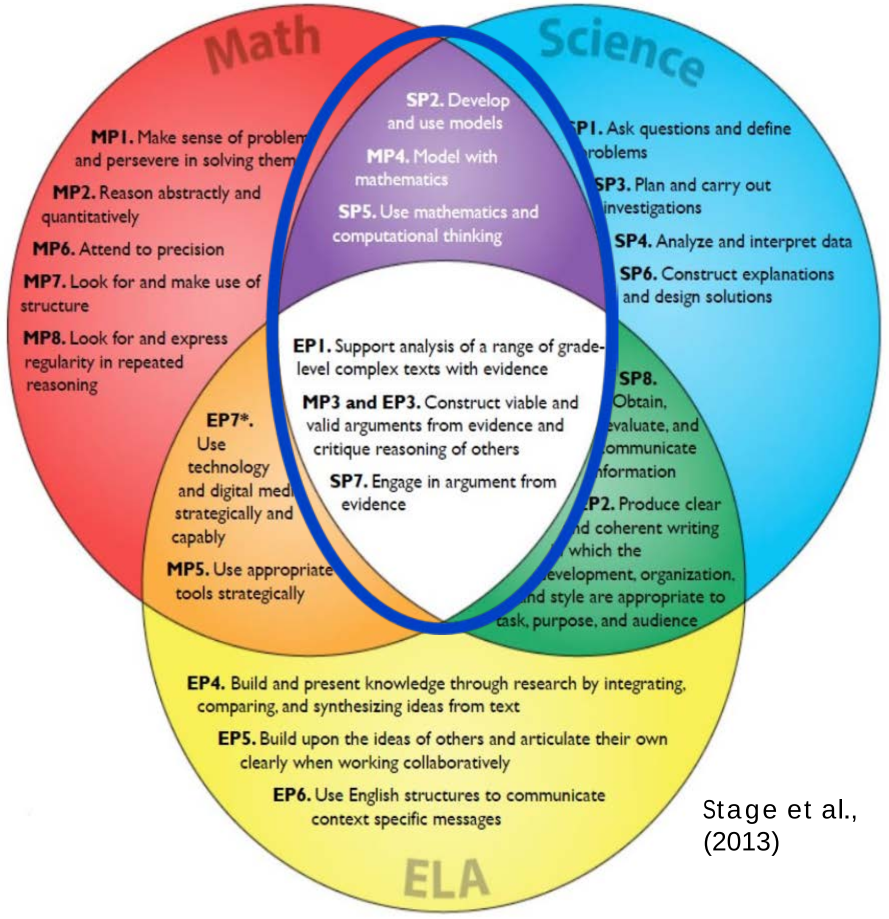
Course Characteristics

- Emphasized relevance. Why do students need to learn this?
- Emphasized practice-based teaching and building student conceptual understanding.
- Student and teacher “hats” (shifting perspectives for learning and reflection)
  - student activities, classroom video, student work
- Lesson and unit planning

Math and Science Methods

Overlapping Practices

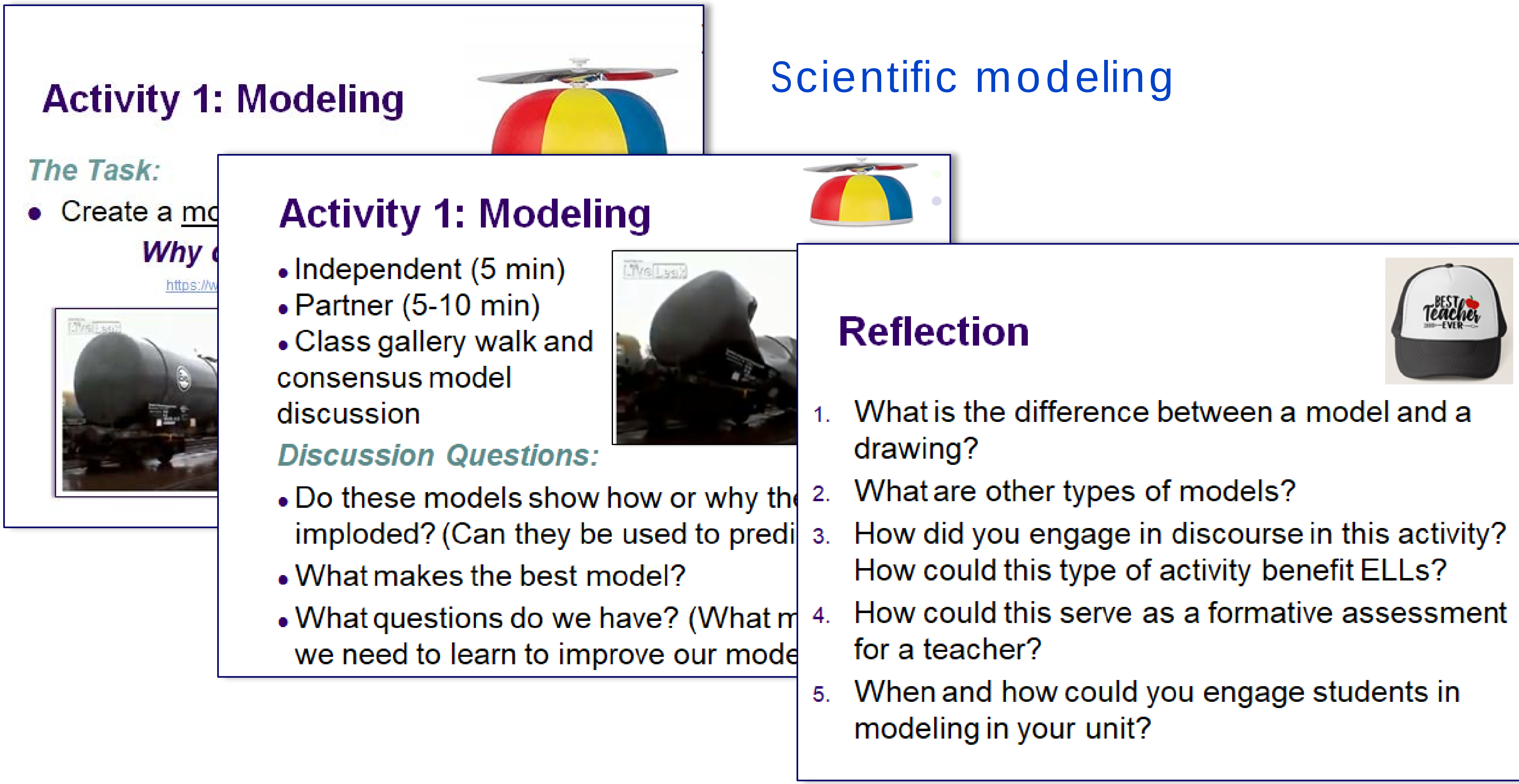
1. Use mathematics/ computational thinking
2. Develop and use models/ model with mathematics
3. Explanation and reasoning
4. Engage in argument from evidence
5. Engineering



Stage et al., (2013)

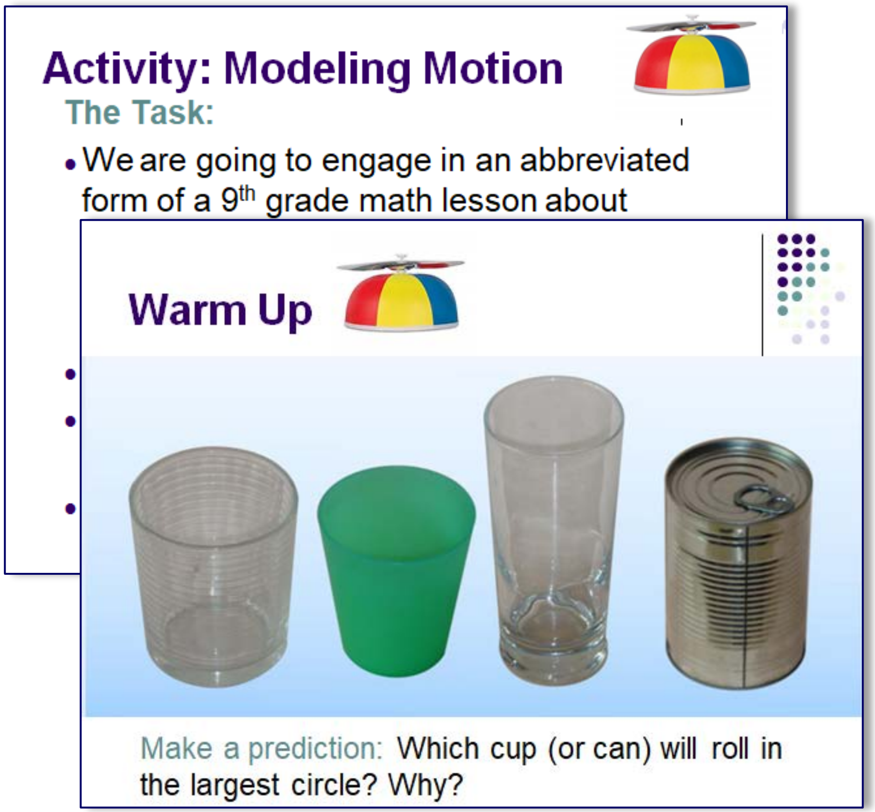
Math and Science Methods

Scientific modeling

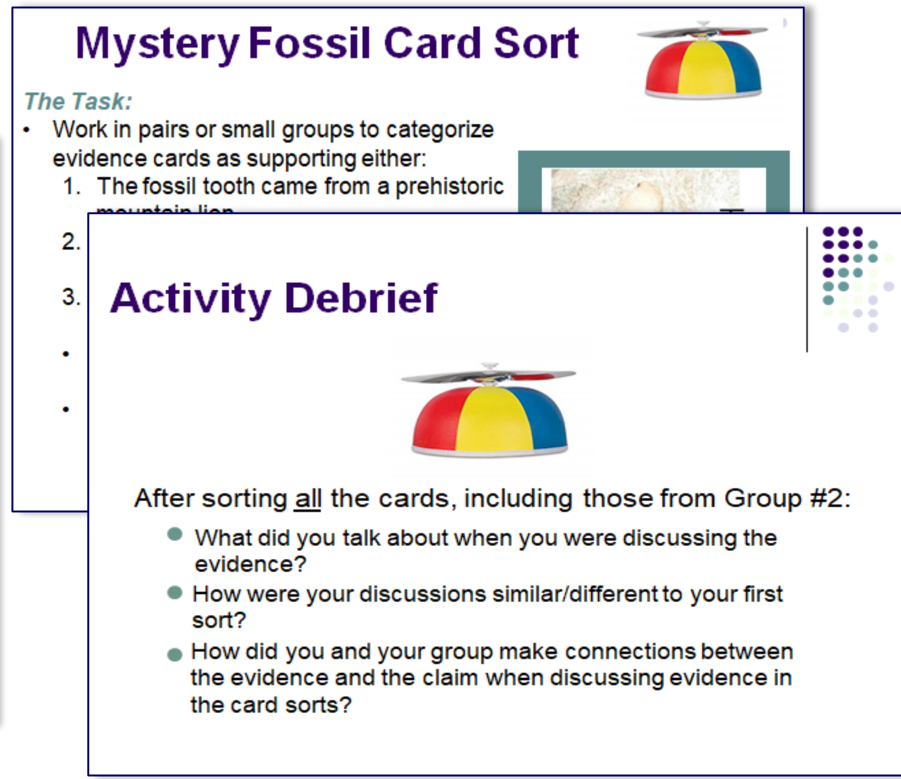


Math and Science Methods

Modeling (math)

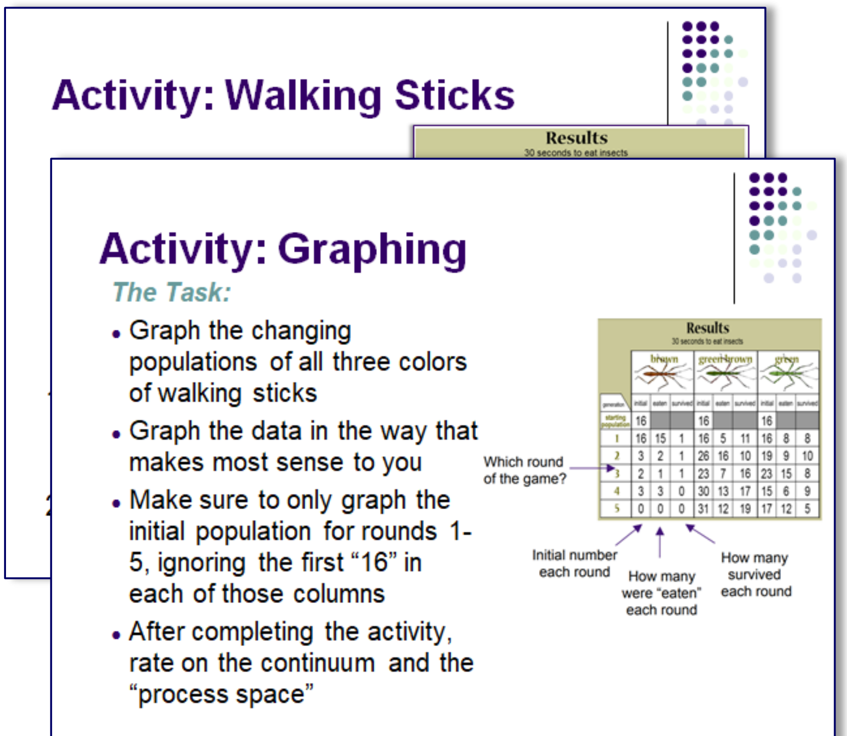


Constructing explanations and engaging in argument from evidence

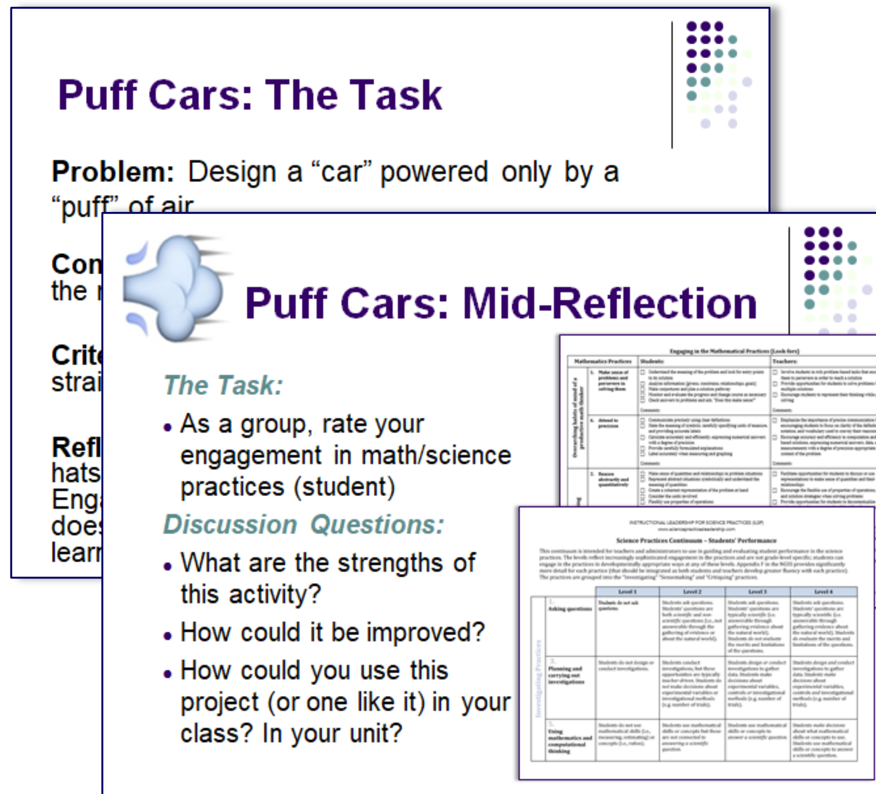


Math and Science Methods

Mathematical and computational thinking



Engineering design



Methods: Participants

The Class

- 7 students
  - 3 graduate students (2 math, 1 science)
  - 4 undergraduate students (seniors; all math)

Teacher*	Gender	Race/ Ethnicity	Undergraduate Majors	Student Teaching School Type	Student Teaching Courses Taught
Amy	Female	White	Education Mathematics	Catholic HS	Algebra 2 Algebra 3
Denise	Female	White	Education Mathematics	Public HS Low performing	Honors Geometry Computer Science
Grace	Female	White	Education Mathematics	Public HS High performing	Algebra 2 Honors and College Prep
Sabrina	Female	White	Education Mathematics	Public HS High performing	AP Statistics, AP Computer Science Algebra 2

* All names are pseudonyms

Methods

Teacher Action Research Project

- Retrospective

Data Sources

1. Individual Interview (end of program)

2. Math and Science Methods
   - Assignments (reflections, lesson plans, unit plan)

3. Student teaching
   - Observations
   - Lesson plans and teaching artifacts
   - Reflections

4. Teaching dispositions survey (pre, post)

Methods: Analysis

- Coding guided by dispositions (Bialka, 2016; Gresalfi, 2009) and open codes
- Attention to linking beliefs to observable actions (Bialka, 2016)

Findings

1. Dispositions toward math teaching shifted away from didactic methods to a variety of approaches to meet student needs.
   - The methods course precipitated this dispositional shift in two ways:
     a. Providing another model of math teaching than they experienced
     b. Engaging them in practice-based math learning as students
2. Instructional plans and reflections emphasized student problem-solving, sense-making, and real-world relevance.

1. Dispositions toward math teaching shifted away from didactic methods to a variety of approaches to meet student needs.
   - The methods course precipitated this dispositional shift in two ways:
     a. Providing another model of math teaching than they experienced
     b. Engaging them in practice-based math learning as students

"I cannot speak for anyone else, but I know that at least I would not have known so much about student-centered learning and inquiry-based instruction had it not been for your class… You definitely impacted my student teaching experience in such a positive way and showed me so many different teaching strategies and methods that I do not think I would have known about or would have been too scared to try if it had not been for your class."

(Denise, end of year interview)

1. Dispositions toward math teaching shifted away from didactic methods to a variety of approaches to meet student needs.
   - The methods course precipitated this dispositional shift in two ways:
     a. Providing another model of math teaching than they experienced
     b. Engaging them in practice-based math learning as students

"So methods was a really big transformative [course]. So I didn't think about student engagement as much. I didn't think of getting them to do an engagement lesson to get them involved because in high school I didn't do that. It was lecture and take notes and do your homework and come in the next day and do it again. It worked for me so I didn't second guess it until I got into the methods class and saw all of these other options than just doing a lecture every day."

(Sabrina, end of year interview)

1. Dispositions toward math teaching shifted away from didactic methods to a variety of approaches to meet student needs.
   - The methods course precipitated this dispositional shift in two ways:
     a. Providing another model of math teaching than they experienced
     b. Engaging them in practice-based math learning as students

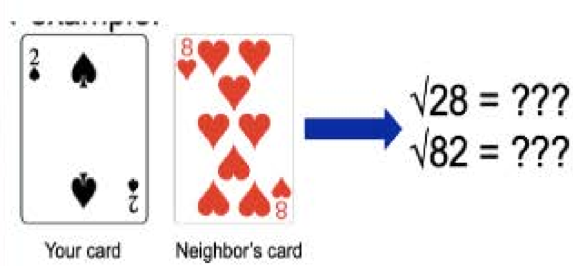
"So we did the mobius strip one and we actually did the activity, and the puff cars. Those were really good for dispositional growth and rethinking what we would do in the classroom and putting us in the position of the students to see what we would do in the lesson."

(Sabrina, end of year interview)

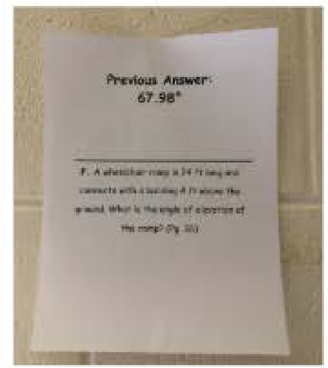
2. Instructional plans and reflections emphasized student problem-solving, sense-making, and real-world relevance.

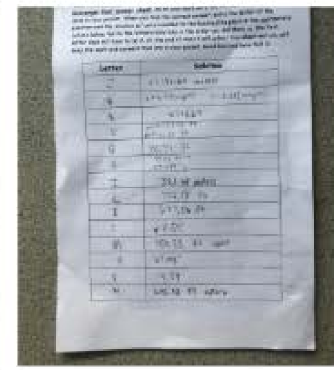
THEOREM DISCOVERY

JENGA GAME



USING COMMON OBJECTS FOR MATH REVIEW



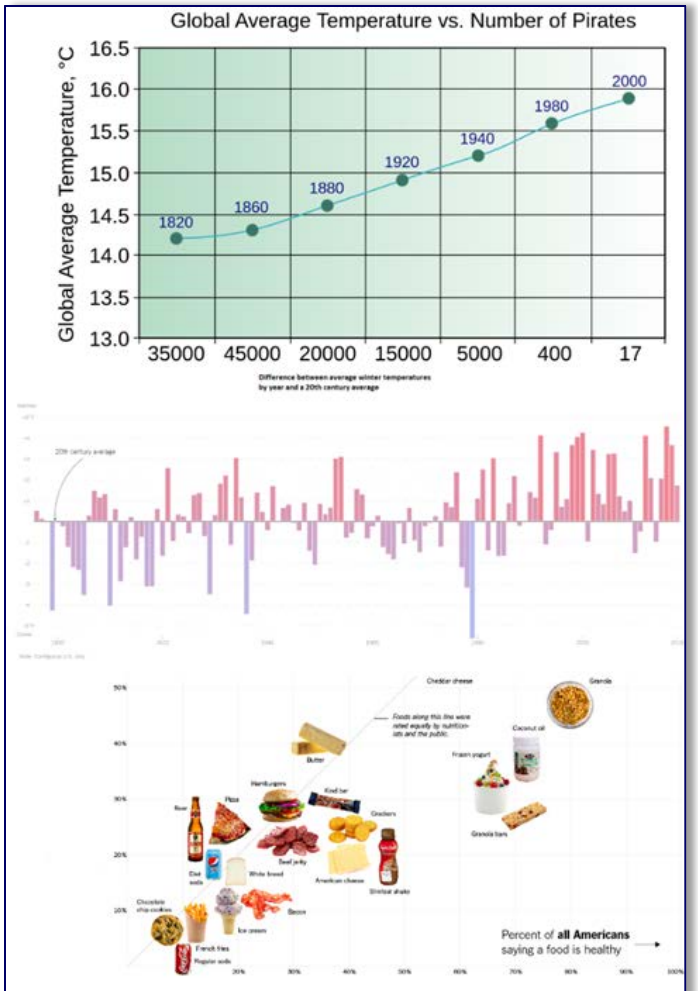


REAL WORLD APPLICATION/SCAVENGER HUNT

"Throughout student teaching I have developed many hands-on, engaging lessons and review activities to compliment the packets… I have seen that during these activities, students are more engaged and excited to learn as they change up our normal routine of lecturing and independent/group practice."

(Denise, end of student-teaching reflection)

2. Instructional plans and reflections emphasized student problem-solving, sense-making, and real-world relevance.



"The main goal of Graph of the Day was to emphasize the importance of statistics in the world around us and to find a fun and relevant way to get students thinking more critically when encountering graphs in their every day lives."

(Sabrina, end of student teaching reflection)

Conclusion

- Pre-service teachers' dispositions toward mathematics influenced their initial teaching priorities
- Methods courses can disrupt these content-based pre-dispositions by:
  - engaging in a wide variety of learning experiences as a student;
  - "forcing" teachers to test out a wide variety of activities;
  - encouraging teacher reflection and introspection (Marco-Bujosa et al., 2017), specifically about the nature of math (Gutierrez, 2012; Sellars, 2016)
- These content-based dispositional shifts allowed them to sustain their pedagogical priorities as student teachers.

Implications

- Pre-service teachers need more opportunities to confront their beliefs about the nature of math/science.
- Pre-service teachers need to experience the disciplinary practices in order to understand how and why they are different from traditional approaches of math teaching.
- More integration of social justice, particularly for math and science education majors (e.g. Gutierrez, 2012)

Questions…?

Discussion Questions

1. What other strategies and activities have you used to encourage pre-service teachers to reflect on their dispositions toward math or science (or beliefs and values related to these disciplines?)

2. In our program, teachers take their content coursework separately from education, meaning they are "socialized" into mathematics while we are trying to socialize them into education. How do we balance and leverage these experiences to better prepare math teachers?

3. How do you integrate social justice strategies into math and science methods courses and teacher education programs?

References

Berland, L. K., Schwarz, C. V., Krist, C., Kenyon, L., Lo, A. S., & Reiser, B. J. (2016). Epistemologies in practice: Making scientific practices meaningful for students. *Journal of Research in Science Teaching*, *53*(7), 1082-1112.

Bialka, C. (2016). Beyond knowledge and skills: Best practices for attending to dispositions in teacher education programs. *Issues in Teacher Education*, *25*(2), 3.

Gresalfi, M. S. (2009). Taking up opportunities to learn: Constructing dispositions in mathematics classrooms. *The Journal of the learning sciences*, *18*(3), 327-369.

Gutierrez, R. (2012). Context matters: How should we conceptualize equity in mathematics education? In J. Choppin, B. Herbel-Eisenmann, & D. Wagner (Eds.), *Equity in discourse for mathematics education: Theories, practices, and policies* (pp. 17–33). New York: Springer.

Marco-Bujosa, L., Gonzalez-Howard, M., McNeill, K., & Loper, S. (2017). Designing and using multimedia modules for teacher educators: Supporting teacher learning of scientific argumentation. *Innovations in Science Teacher Education*, *2*(4).

Selling, S. K. (2016). Making mathematical practices explicit in urban middle and high school mathematics classrooms. *Journal for Research in Mathematics Education*, *47*(5), 505-551.

Stage, E. K., Asturias, H., Cheuk, T., Daro, P. A., & Hampton, S. B. (2013). Opportunities and challenges in next generation standards. *Science*, *340*(6130), 276-277.

Thank You!

Special thanks to Allison Kramer and Lauren Baker, Villanova University for their assistance with analysis, and for the four teachers for their participation.

website:
lisamarcobujosa.weebly.com

email:
lisa.marco-bujosa@villanova.edu