Preparing Mathematics Teachers to Teach Modeling

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Outline

Section Goals

1. Explore the *challenges* and *opportunities* associated with preparing teachers to teach modeling as envisioned in the CCSSM.
2. Identify *questions* and *resources*.
3. *Document* our discussions.

Section Overview

- A brief background: why this topic is relevant and urgent.
- Two rounds of structured small group discussion followed by whole group discussion.
  - **D.1** What do teachers need to know?
  - **D.2** How can we prepare them?

Modeling

- One of the eight K-12 practice standards
  - "Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace."
- A high school **conceptual category**
  - "Modeling is best interpreted not as a collection of isolated topics but rather in relation to other standards."
  - Modeling is a messy process: "Real-world situations are not organized and labeled for analysis; formulating tractable models, representing such models, and analyzing them is appropriately a creative process."

- For K-8, opportunities for modeling are not starred in the standards as they are for high school

CBMS Recommendations

From The Mathematical Education of Teachers II (2012)

- **<u>Recommendation 1.</u>** Prospective teachers need mathematics courses that develop a solid understanding of the mathematics they will teach.

- **<u>Recommendation 4.</u>** All courses and professional development experiences for mathematics teachers should develop the habits of mind of a mathematical thinker and problem-solver, such as reasoning and explaining, modeling, seeing structure, and generalizing.

CBMS Recommendations

From The Mathematical Education of Teachers II (2012)

- **Recommendation 5.** At institutions that prepare teachers or offer professional development, teacher education must be recognized as an important part of a mathematics department's mission and should be undertaken in collaboration with mathematics education faculty. More mathematics faculty need to become deeply involved in PreK-12 mathematics education by participating in preparation and professional development for teachers and becoming involved with local schools or districts.

CBMS Recommendations

- "The Common Core State Standards include an emphasis on modeling in high school, and **prospective teachers should have experience modeling rich real world problems.** This includes some aspects of quantitative literacy: the ability to construct and analyze statistical models; the ability to construct and analyze expressions, equations, and functions that serve a given purpose, derived either from a real-world context or from a mathematical problem, and to express them in different ways when the purpose changes; and the ability to understand the limitations of mathematical and statistical models and modify them when necessary."

CBMS Recommendations

Two sample undergraduate Mathematics sequences for high school teachers:

- **Short sequence** (33 semester-hours) & **long sequence** (42 semester-hours).
- The long sequence includes "Geometry or Mathematical Modeling (3 semester-hours)"

D.1: Teacher Knowledge

Discuss <u>any or all</u> of the following questions within your group.

D.1.1 What does a teacher need to know in order to implement a modeling lesson?

D.1.2 How is this knowledge different from what is needed to recognize and implement opportunities for modeling throughout the curriculum?

D.1.3 How is success in teaching modeling related to beliefs about mathematics?

D.1.4 In your experience, how do pre- and in-service teachers perceive mathematical modeling?

D.1.5 What research questions would you like answered about teachers' preparation for or beliefs about modeling?

D.1.6 What challenges exist in assessing a (pre-service) teacher's knowledge of modeling?

D.2: Teacher Preparation

Discuss <u>any or all</u> of the following questions within your group.

D.2.1 What is currently done in your departments that prepare secondary teachers to teach modeling? Elementary teachers? Middle school teachers?

D.2.2 If a course on mathematical modeling were to be offered to pre-service teachers, what should be included? What resources are available? Needed? Who should be involved in the development of such a course?

D.2.3 How is your state or district implementing the modeling standards?

D.2.4 How well prepared are mathematics teacher educators for the challenge of preparing teachers?

D.2.5 How can we prepare pre-service teachers to teach modeling? How can we support in-service teachers?

How can we support each other?

Thank you

This presentation and notes from our discussions will be available on Jen-Mei's website:

`http://www.csulb.edu/~jchang9/talks.html`.

Resources

- COMMathematical AP, the Consortium for Mathematics and Its Applications
  - Modeling Handbook `www.comap.com/modelingHB`
- MASTER Modeling And Simulation Tools for Education Reform
  - `http://www.shodor.org/master/`
- The International Community of Teachers of Mathematical Modelling and Applications
  - `http://ictma.net/`

SMP 4

CCSS.Math.Practice.MP4 Model with mathematics:

- Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. In early grades, this might be as simple as writing an addition equation to describe a situation. In middle grades, a student might apply proportional reasoning to plan a school event or analyze a problem in the community. By high school, a student might use geometry to solve a design problem or use a function to describe how one quantity of interest depends on another.

SMP 4 Continued

- Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. They are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.

CCSSM HS Modeling Examples

- Estimating how much water and food is needed for emergency relief in a devastated city of 3 million people, and how it might be distributed.
- Planning a table tennis tournament for 7 players at a club with 4 tables, where each player plays against each other player.
- Designing the layout of the stalls in a school fair so as to raise as much money as possible.
- Analyzing stopping distance for a car. Modeling savings account balance, bacterial colony growth, or investment growth.
- Engaging in critical path analysis, e.g., applied to turnaround of an aircraft at an airport.
- Analyzing risk in situations such as extreme sports, pandemic, and terrorism.
- Relating population statistics to individual predictions.