Changing Classroom Practices through micro-credentialing

Creating meaningful modeling lessons for high-school chemistry classrooms

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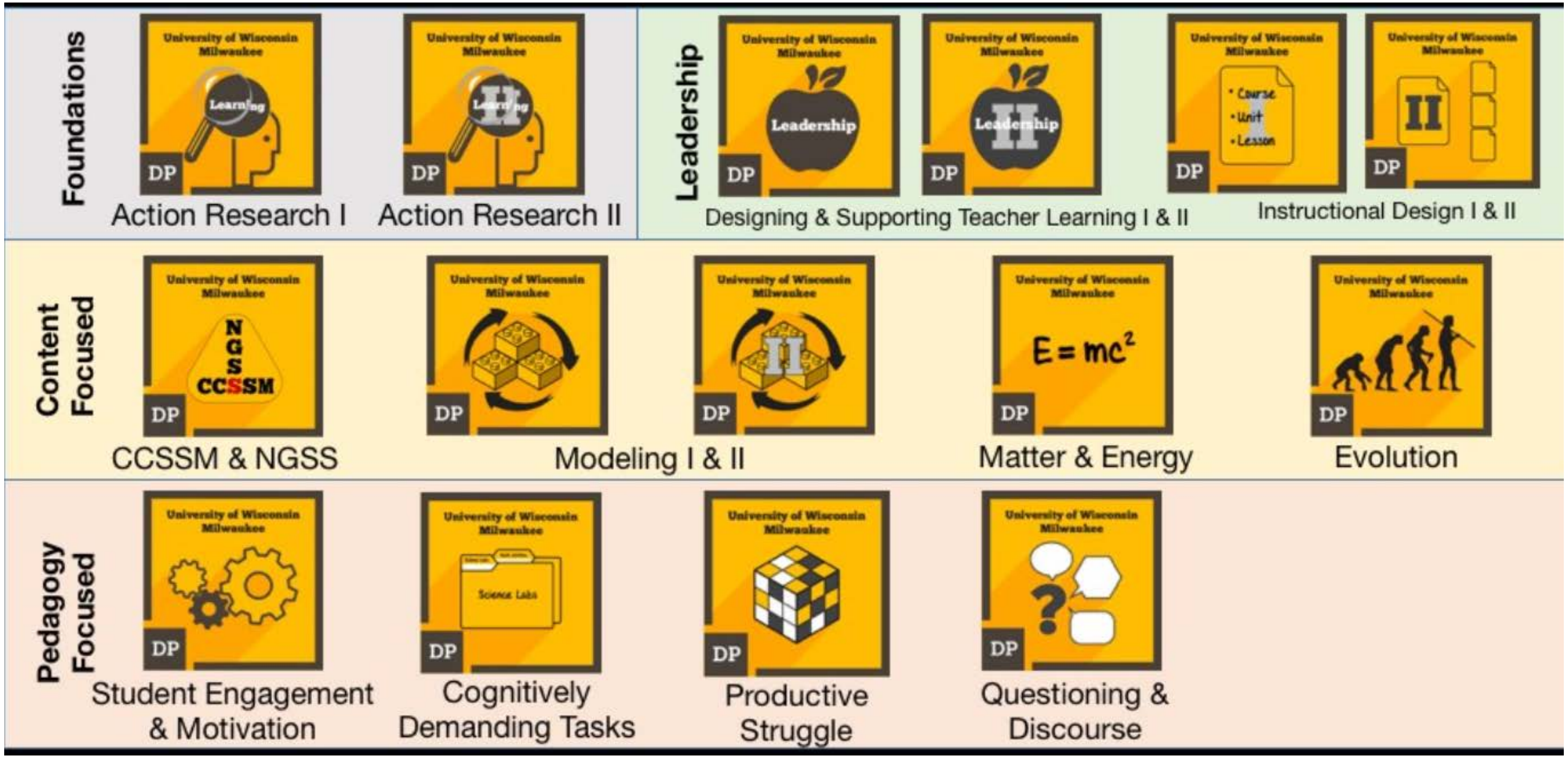
National Science Foundation Noyce Track 3 Master Teacher Fellows Project (5 year project)

Participants: 24 high school mathematics and science teachers with Masters degrees

Tasks: Teachers complete four action research-based micro-credentials per year on the Digital Promise platform

Project Goal: Anticipated changes in:
1. Teacher capacity for action research
2. Instructional practices related to focus of micro-credentials (content, pedagogy)
3. Quality of instruction overall

Sample Micro-credentials (digitalpromise.org)



Multiple micro-credential levels

Level 1. Conduct action research in your own class

Level 2. Engage other teachers in your building or across buildings in action research

Level 3. Design and conduct teacher professional development on research topic

MMTP Theoretical Underpinnings

Practice-based teacher development

- Action research as a means to develop content and pedagogical knowledge
- Research-practice-research cycle

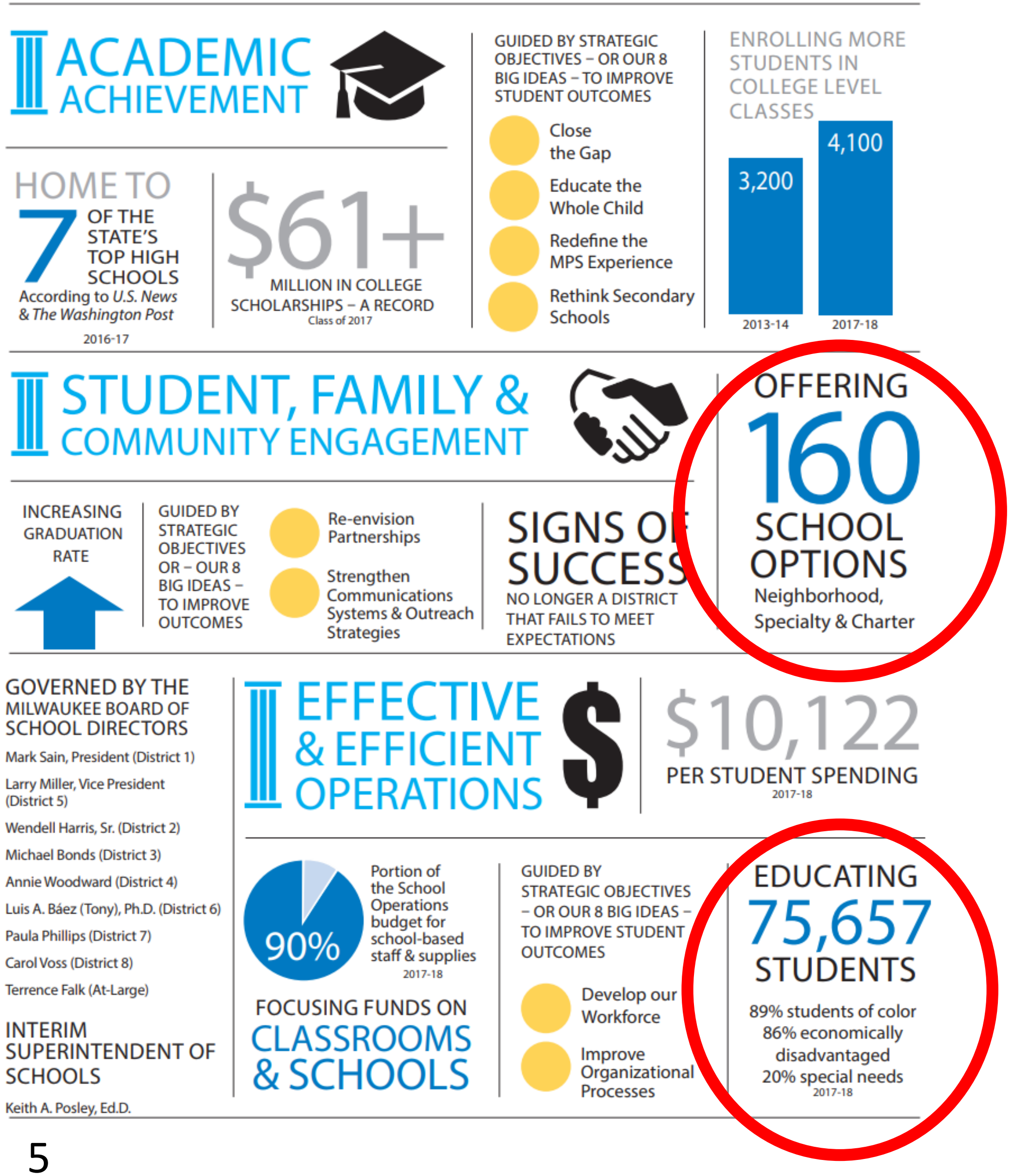
Ensuring teacher voice

- Choices in areas of inquiry (Years 2-5)

Development of teacher leaders

- Position teachers as professional developers within district
- Develop next-generation district curriculum leaders

Milwaukee Public Schools (2017-2018)



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Models and Modeling II (Science)

Competency

Educator investigates the ways in which a modeling task can help to surface student misconceptions. Educator plans and analyzes a modeling lesson designed specifically to elicit misconceptions and incomplete reasoning, and evaluates student performance based on both content and process.

Key Method

The educator begins by analyzing student work artifacts from a previous lesson to identify misconceptions and incomplete reasoning. The educator identifies a topic for future study within their course in which misconceptions are likely to arise. Using strategies from the provided resources, the educator designs a modeling lesson with the aim of eliciting misconceptions and incomplete understanding and concrete plans to support students in revising their thinking. The educator teaches the lesson and measures student performance related to both content and process.

Method Components

The **Method Components** section elaborates upon the **Key Method,** including a description of the **Key Method** and/or actionable steps or strategies for demonstrating the competency. This is the basis for the artifact submission that is later assessed according to the evaluation criteria.

Components and Implementation of Models and Modeling

- Consider a set of student work from a past lesson and identify what that work tells you (and doesn't tell you) about student misconceptions, incomplete reasoning, and unfinished learning.
- Read an article describing the nature of student misconceptions (as distinct from errors)
- Identify an upcoming science topic that has the potential for student misconceptions.
- Design a modeling lesson related to that science topic, in which the process of science modeling will potentially surface misconceptions or incomplete reasoning.
- Vet the lesson plan with a colleague to receive feedback.
- Teach the lesson, and assess student performance based on both their progress with the science content and the science modeling processes. (Optional: Invite a colleague to observe the lesson.)
- Collect and synthesize teacher and student reflections on the lesson.

Supporting Rationale and Research

Research citations substantiate the effectiveness of the **Competency** and **Key Method** and must be put in MLA format. Optionally, this section can include a brief summary of the research to provide the earner with the general **Rationale** for why successful demonstration of the **Competency** can be achieved through the selected **Key Method**.

Science Resources

Reasoning from Models - Using metacognitive modeling in the physics classroom.(2017), The Science Teacher, **9**, pg. 37-42

Modeling-based teaching in Science Education. Gilbert, J.K., Justi, R., (2016). Volume 9, Chapter 3 (pg. 41-56), Towards Authentic Learning in Science Chapter 4 (pg. 57-80), Approaches to Modelling Based Teaching

Models and Modeling-cognitive Tools for Scientific Enquiry Volume 6 (2011), Chapter 5, pg 99-120, Helping Students Construct Robust Conceptual Models by Colleen Megowan-Romanowicz

Rationale

In the first Modeling badge, you made connections between the current set of national standards, detailed reports focused on modeling, and the teaching of modeling in your classroom context. Building on that understanding, we will explore together the ways in which modeling lessons can help identify and dispel student misconceptions. You will analyze student work from a recent lesson of your own to identify how misconceptions might present themselves, engage in some reading about misconceptions related to secondary mathematics content, and design and implement a modeling lesson that targets misconceptions.

The ideas in this badge are specifically designed for the teaching and learning of secondary science. Similar distinctions exist in mathematics; the Models and Modeling II (Mathematics) badge contains those resources. We recommend completing the first Models and Modeling badge before this one.

Learning Opportunities

Part 1: Identifying Misconceptions

1. Collect a set of student work from a task that you have recently implemented. This student work should have the potential to illuminate one or more important misconceptions or aspects of incomplete/unfinished thinking.
   a. Misconceptions are conceptual and more significant than simply procedural errors or calculation mistakes
   b. Rich tasks of high cognitive demand have the greatest potential to illuminate misconceptions
2. Analyze your student work. What correct conceptions can you identify in the work, and how are they evident? What sorts of incomplete thinking do you see? What misconceptions are illuminated?
   a. Sort your work into types of correct thinking, misconceptions, and incomplete thinking
   b. Give a name to each group and describe how you determined that a particular piece of student work went into a particular category
3. Consider the following: How might a task focused on models and modeling help you as a teacher identify misconceptions and incomplete thinking, and how might such a task provide ***students*** with meaningful opportunities to identify and work through misconceptions and incomplete thinking?

Part 2: Digging Into Misconceptions

4. Read the the following articles that focuses mostly on chemistry related examples but also provide general information about misconceptions and implications for teaching:
   a. Kind, Vanessa, (2004), Beyond Appearances: Students' misconceptions about basic chemical ideas, 2nd Edition
   b. American Psychological Association http://www.apa.org/education/k12/misconceptions.aspx
   c. Barke , H.D., Hazari, A., Yitbarek, S., (2009) Misconceptions in Chemistry, Chapter 2 pg 21-35, Springer Verlag Berlin Heidelberg
   d. Or use Google Scholar or other online resources such as ERIC EBSCO to identify an article that unpacks student misconceptions in the science concept area you selected.
5. Identify an upcoming unit with a science topic that you believe has the potential to address specific student misconceptions, and that lends itself well to a modeling task.

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