



Model with Mathematics

Competency

Educators will engage and support students to model with mathematics.

Key Method

Educators will analyze a student task and student proficiency levels to explain Mathematical Practice Standard 4, *Model with Mathematics*, to stakeholders.

Method Components

Mathematical Practices

The Standards for Mathematical Practice describe varieties of expertise that mathematics educators at all levels should seek to develop in their students. These practices rest on important “processes and proficiencies” with longstanding importance in mathematics education.

The first of these is the [NCTM process standards from the National Council of Teachers of Mathematics \(NCTM\)](#). The second is the strands of mathematical proficiency specified in the National Research Council's report [Adding It Up](#).

These process standards are:

- Problem-Solving
- Reasoning and Proof
- Communication
- Connections
- Representation



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Strive to build these dispositions in students:

- Adaptive reasoning
- Strategic competence
- Conceptual understanding
- Procedural fluency
- Productive struggle

These are the eight standards for mathematical practice:

1. Make sense of problems and persevere in solving them
2. Reason abstractly and quantitatively
3. Construct viable arguments and critique the reasoning of others
4. Model with mathematics
5. Use appropriate tools strategically
6. Attend to precision
7. Look for and make use of the structure
8. Look for and Express regularity in repeated reasoning

Talking about Mathematics: The importance of language in mathematics instruction and practice

Mathematics is a language and students need to become proficient in it. In the process, students need to understand and routinely apply the language of mathematics, which includes vocabulary, symbols, and sentence structures. The language of mathematics crosses all the standards for mathematical practice, so providing ample opportunities for students to learn and apply this language, both independently and collaboratively, will support their mathematical proficiency.

Explaining math can include the following:

- Words
- Pictures
- Mathematical expressions
- Using visual aids such as graphs
- Number lines
- Diagrams
- Drawing shapes with arm movement

Using the visuals above will help all students but especially those with multi-lingual skills.

Assessing Mathematics

Assessing student learning is vital to progress in learning and steering instruction to ensure learning growth. It's important to ensure that assessments include these core components:



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- Outcomes that are clear and measurable
- Opportunities for learners to show in a variety of ways, that they understand outcomes
- Assessment results that can be used to change instruction as needed to improve student learning

Model with Mathematics

Model with mathematics disposition is the tendency to see mathematics as a tool to solve real-world problems and to understand complex phenomena. Here are some key characteristics of individuals with strong mathematics modeling:

- They have a deep understanding of mathematical concepts and can apply them to real-world situations
- They can identify and define variables and parameters in mathematical models and use them to make predictions and solve problems
- They can analyze the validity of models and refine models to be more effective.
- They are comfortable working with data, using statistical methods to analyze and interpret it
- They are creative problem solvers who can think outside the box and develop innovative solutions to complex problems
- They have strong communication skills and can explain their mathematical models and predictions in a clear and concise manner to a variety of audiences
- They are lifelong learners who seek out opportunities to improve their mathematical knowledge and skills

Assessing Mathematical Modeling

Assessment in mathematical modeling is complex because it is iterative. Formative assessment provides an approach to support math modeling tasks. Rubric scores are not suggested for assessing mathematical modeling because of the complex nature of the modeling tasks. It is suggested to use students' modeling scores as a holistic approach or the different phases of the modeling process. To learn more, go to [Classroom Assessment of Mathematical Modeling Tasks](#).

Strategies to Teach Mathematics Modeling



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Model with mathematics is a strategy for the teacher to re-focus their efforts on real-world problem-solving mentalities to better engage learners. It's different than a traditional learning path where there is one way to learn something, instead, it's cyclical. Teachers should use real-world questioning techniques to make problems relevant but also demand students to do more than consider one method to solve equations.

Strategies may include the following:

- Celebrating the use of models and different types of math reasoning.
- Asking non-routine problems
- Encouraging students to use multiple representations of their mathematical thinking and reasoning
- Encouraging students to use visual representations and manipulatives in their reflection
- Asking learners to find multiple solutions and multiple ways to solve a problem
- Having learners share understandings in various ways
- Using talk moves
- Actively listen
- Acknowledging multiple ways students solve mathematical problems
- Using read-aloud to spark discussion
- Recognizing perseverance and growth

Supporting Rationale and Research

Clayton, H. (2014). Thinking Behind the Content: Standards for Mathematical Practice. Just ASK Publications. Retrieved November 7, 2022, from <https://justaskpublications.com/just-ask-resource-center/e-newsletters/msca/thinking-behind-the-content-standards-for-mathematical-practice/>

Elementary Math at EDC. (2020). *MP: Why do we need standards for Mathematical Practice? – Elementary Math*. Elementary Math. Retrieved November 7, 2022, from <https://elementarymath.edc.org/resources/why-do-we-need-standards-for-mathematical-practice/>

Ernst-Slavit, G., & Slavit, D. (2021). *Mathematically Speaking*. Language Magazine. Retrieved November 7, 2022, from <https://www.languagemagazine.com/mathematically-speaking/>

Illustrative Mathematics. (2016). Illustrative Mathematics. Retrieved November 7, 2022, from <http://tasks.illustrativemathematics.org/practice-standards/>



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Jamison, R. E. (2000, May). Learning the Language of Mathematics. *Language and Learning Across the Disciplines*, 4(1), 45-54.

<https://wac.colostate.edu/docs/llad/v4n1/jamison.pdf>

Keazer, L., & Jung, H. (2020). Prospective teachers anticipate challenges fostering the mathematical practice of making sense. *School Science and Mathematics*, 120(2), 78-89. <https://onlinelibrary.wiley.com/doi/10.1111/ssm.12390>

Made4Math. (2020, May 12). *9 Easy Tips for Teaching Standards for Mathematical Practice*. Made4Math. Retrieved November 7, 2022, from

<https://www.made4math.com/standards-for-mathematical-practice/>

Rosenfeld, R. (2020, October 4). *Extending the Mathematical Practice Standards Across the Curriculum*. WestEd. Retrieved November 7, 2022, from

<https://www.wested.org/wested-bulletin/insights-impact/mathematical-practice-standards-across-the-curriculum/>

The University of Texas at Austin Charles A. Dana Center. (2022). *Mathematical Practice Standards*. Inside Mathematics. Retrieved November 7, 2022, from

<https://www.insidemathematics.org/common-core-resources/mathematical-practice-standards>

Resources

Curriculum and Standards

[Classroom Resources - National Council of Teachers of Mathematics](#)

[Achievethecore.org:Instructional Content Nav - Mathematics: Focus by Grade Level](#)

[Math Ed Reports](#)

[Mathematics for All: How Modeling Transforms Student Learning
Mathematics Standards](#)

[MP4 Examples](#)

[MP4 Model with Mathematics – Elementary Math](#)

[Process - National Council of Teachers of Mathematics](#)

[Standard 4: Model with Mathematics](#)



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[Standards for Mathematical Practice](#)

[The Standards for Mathematical Practice & Instructional Materials - Peers and Pedagogy](#)

[Deep Dive: Mathematics for All – How Modeling Transforms Student Learning](#)

Assessment and Strategies for Mathematics

[6 Simple \(But Effective\) Instructional Strategies for Mathematics](#)

[9 Easy Tips for Teaching Standards for Mathematical Practice](#)

[Classroom Assessment of Mathematical Modeling Tasks](#)

[Math Reasoning: Problem-Solving Strategies](#)

[Talk moves](#)

[Fostering Math Practices Analyzing Contexts and Models](#)

Submission Guidelines & Evaluation Criteria

To earn the micro-credential, you must receive a passing score in Parts 1 and 3 and be proficient in all components in Part 2.

Part 1. Overview Questions (Provides Context)

(250-400)

Please use the suggested word count as a guide to answer the following contextual questions. This will help our assessor understand your current context for working on this micro-credential.

Please do not include any information that will make you identifiable to your reviewers.

1. Why did you choose to work on this micro-credential? (Include your career goals and current teaching assignment)
2. What is your experience with Math Practices?
3. Describe your student demographics.



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4. As a result of working on this micro-credential, what would you like your students to be able to do?

Passing: Response provides reasonable and accurate information that justifies the reason for choosing this micro-credential to address the specific needs of both the teacher and the student. Clearly state a learning goal that describes what you hope to gain from earning this micro-credential and how your students may benefit.

Part 2. Work Examples/Artifacts/Evidence

To earn this micro-credential please submit the following three artifacts as evidence of your learning.

Please do not include any information that will make you or your students identifiable to your reviewers.

Artifact 1: Task Analysis

Extract a problem or task from a lesson that allows students to engage in Math Practice 4. Utilize the implementation characteristics identified under Math Practice 4 on [Achieve the Core's Implementing Standards for Mathematical Practices](#) to analyze the problem or task.

Task analysis must include the following:

- The problem or task
- The mathematics standard(s) addressed and any learning objectives/outcomes
- How the task addresses the implementation characteristics

Artifact 2: Annotated Student work from task

Teach the task you analyzed in Artifact 1 and upload two student work samples that reflect different levels of proficiency in Math Practice 4. The samples must include these:

- Annotations that identify at least one strength for each student
- Annotations that identify at least one step toward proficiency for each student

OR

Make a 2-minute video that shows you teaching and interacting with students for the task you analyzed in Artifact 1

Your video must include the following:

- Verbal identification of one strength (either during the recorded conversation or in a voiceover)



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- For example: While working with your student(s), pause and say something like, “I am noticing that you are good at _____.”
- Verbal identification of at least one step toward proficiency for each student (either during the recorded conversation or in a voiceover)
 - For example: At the end of the lesson, say to your student(s) “I am so proud of the way you----. A good next step for you to work on is----.”

Follow your district's mandated permissions for photography with students.

Video tips: Video students from the back of the head or from the neck down; avoid or block their faces. Narrate or display information to explain the learning intended for the Math Practice.

**You will need to upload your video to YouTube or another video hosting platform. Please make sure your sharing permissions are set to anyone with the link can view it. You can change this after you have earned this micro-credential.*

Artifact 3: One Page Handout

Use [Achieve the Core's Implementing Standards for Mathematical Practices](#) to create a one-page handout for families and/or support professionals that synthesizes how they can support students at home or at school with mathematical modeling. Your one-page handout needs to include:

- The intended audience: families, support professionals, or both
- Explanation of Math Practice 4
- Description of what students should be able to do (in a language student can understand)
- Questions and/or prompts (2-3) to guide students through the process
- What to do when a student is stuck
- Resources/links (1-3)to use at home, in a resource room, or another location

Part 2. Rubric

	Proficient	Basic	Developing
Artifact 1: Task Analysis	The task analysis includes all the following: <ul style="list-style-type: none"> ● The problem and task ● The math standard(s) and objectives and outcomes 	The task analysis includes some of the following: <ul style="list-style-type: none"> ● The problem and task ● The math standard(s) and objectives and outcomes 	The task analysis does not sufficiently include any of the following: <ul style="list-style-type: none"> ● The problem and task ● The math standard(s) and objectives and outcomes



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	<ul style="list-style-type: none"> • The Four Implementation Characteristics of Mathematical Practice 4 • How the task addresses the implementation characteristics 	<ul style="list-style-type: none"> • The Four Implementation Characteristics of Mathematical Practice 4 • How the task addresses the implementation characteristics 	<ul style="list-style-type: none"> • The Four Implementation Characteristics of Mathematical Practice 4 • How the task addresses the implementation characteristics
<p>Artifact 2: Student Evidence from Task</p> <p>Samples of Student Work</p> <p>Option</p>	<p>Student samples include all the following:</p> <ul style="list-style-type: none"> • Two samples displaying different levels of Math Practice 4 • Written annotations that identify at least one strength for each student • Written annotations that identify at least one step toward proficiency for each student 	<p>Student samples include some of the following:</p> <ul style="list-style-type: none"> • Two samples displaying different levels of Math Practice 4 • Written annotations that identify at least one strength for each student • Written annotations that identify at least one step toward proficiency for each student 	<p>Student samples do not sufficiently include any of the following:</p> <ul style="list-style-type: none"> • Two samples displaying different levels of Math Practice 4 • Written annotations that identify at least one strength for each student • Written annotations that identify at least one step toward proficiency for each student
<p>Artifact 2: Student evidence from task</p> <p>Video</p> <p>Option</p>	<p>Video includes all the following:</p> <ul style="list-style-type: none"> • At least one strength (either during the recorded conversation or in a voiceover) • At least one step toward proficiency for each student (during the 	<p>Videos include some of the following:</p> <ul style="list-style-type: none"> • At least one strength (either during the recorded conversation or in a voiceover) • At least one step toward proficiency for each student (during the 	<p>Videos do not sufficiently include the following:</p> <ul style="list-style-type: none"> • At least one strength (either during the recorded conversation or in a voiceover) • At least one step toward proficiency for each student



	recorded conversation or in a voiceover)	recorded conversation or in a voiceover)	(during the recorded conversation or in a voiceover)
Artifact 3: One Page Handout	<p>The one-page handout clearly shows how to help students model with mathematics.</p> <p>And includes all the following:</p> <ul style="list-style-type: none"> Your intended audience: families, support professionals, or both Explanation of Math Practice 4 What students should be able to do (in a language students can understand) 2-3 Questions and/or prompts (2-3) to guide students through the process What to do when a student is stuck Resources/links (1-3) to use at home, in a resource room, or in another location 	<p>The one-page handout attempts to show how to help students model with mathematics.</p> <p>It includes all but two of the following:</p> <ul style="list-style-type: none"> Your intended audience: families, support professionals, or both Explanation of Math Practice 4 What students should be able to do (in a language students can understand) Questions and/or prompts (2-3) to guide students through the process What to do when a student is stuck Resources/links (1-3) to use at home, in a resource room, or in another location 	<p>The one-page handout does not show how to help students model with mathematics.</p> <p>It is missing three or more of these:</p> <ul style="list-style-type: none"> Your intended audience: families, support professionals, or both Explanation of Math Practice 4 What students should be able to do (in a language students can understand) Questions and/or prompts (2-3) to guide students through the process What to do when a student is stuck Resources/links (1-3) to use at home, in a resource room, or in another location



Part 3 Reflection

(400-600 words)

Use the word count as a guide to write a personal reflection about your work on this micro-credential. For tips on writing a good reflection, review this resource:

[How Do I Write a Good Personal Reflection?](#)

Please do not include any information that will make you identifiable to your reviewers.

1. How did thinking about Math Practice 4 impact how you approached this task? Describe any shifts in understanding for yourself and for your students.
2. Reflect on your role in facilitating student learning about Math Practice 4 on this task. In your response, include specific details from student work and your feedback on Artifact 2.
3. What next steps can you take moving forward? How will you make this process part of your regular practice?

Passing: Reflection provides evidence that this activity has had a positive impact on both educator practice and student success. Specific examples are cited from personal or work-related experiences to support claims. Also included are actionable steps that demonstrate how new learning will be integrated into future practices.



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