



Make Sense of Mathematical Problems and Persevere in Solving Them

Competency

Educators will engage with and support students so that they can make sense of mathematical problems and persevere in solving them.

Key Method

Educators will analyze students' tasks, and proficiency levels to explain mathematical practice standard 1, *Make Sense of Problems and Persevering to Solve Them*, 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:



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

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.



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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:

- 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

Make Sense of Mathematical Problems and Persevere in Solving Them

Mathematically proficient students can explain the meaning of problems and look for entry points to solutions. In simple terms, learners can analyze what the mathematical problem is and find a way to solve it.

Students should be able to:

- Explain to themselves the meaning of a problem and find entry points to its solution
- Analyze givens, constraints, relationships, and goals
- Make conjectures about the form and meaning of the solution
- Plan a solution pathway rather than attempt a quick solution
- Consider analogous problems and look at problems in different ways.
- Try special cases and simpler forms of the original problem to gain insight into its solution
- Monitor and evaluate their progress and change course if necessary
- Transform algebraic expressions.
- Explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends
- Rely on using concrete objects or pictures to help conceptualize and solve a problem.
- Check their answers to problems using a different method, and continually ask themselves, "Does this make sense?"
- Understand how others approach solving complex problems and identify what solving these problems looks like

Teaching Strategies that Support Perseverance



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Questioning techniques and pedagogical strategies allow for mathematical stamina to build problem-solvers and mathematical thinkers.

- Focus on process (emphasize that there are often multiple correct answers and multiple paths to reach the correct answer.)
- Honor hard thinking rather than correct solutions
- Give students time to think (a few days may be needed)
- Value all voices and diversity of ideas
- Make thinking through problems part of your classroom culture across all content
- Ask “why” and have students justify their solution strategies.

Supporting Rationale and Research

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/>

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/>

Thinking-Behind-the-Content:-Standards-for-Mathematical-Practice. Just ASK



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Publications. Retrieved November 7, 2022, from <https://justaskpublications.com/just-ask-resource-center/e-newsletters/msca/thinking-behind-the-content-standards-for-mathematical-practice/>

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](#)

[Achieve the Core](#) - Mathematical Practice Guide

[Common Core State Standards for Mathematical Practice](#)

[Math EdReports](#)

[Mathematics Standards](#)

[Practice Standards](#)

Making Sense of Mathematical Problems and Persevere in Solving Them

[MP1 Examples](#)

[PBS Videos on MP 1.](#)

[The Standards for Mathematical Practice & Instructional Materials](#) by Sarah Gallaso

[SMP 1: Make Sense of Problems & Persevere in Solving Them](#) by Sarah Gallaso

[Illustrative Mathematics Overview of each Standard of Mathematical Practice with videos.](#)

[Ohio Department of Education Standards of Mathematical Practice Page](#)



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Family Support

[Engaging Families for Math Success](#)

[Helping at Home: Mathematical Practice Cards for Families | The Math Learning Center](#)

[Making Math a Family Thing | Harvard Graduate School of Education](#)

[Parent strategies for improving their child's math - Teach. Learn. Grow.](#)

For Further Reading

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

[Engage in the Mathematical Practices: Strategies to Build Numeracy and Literacy With K-5 Learners](#)

[MPI Make sense of problems and persevere in solving them – Elementary Math Deep Dive: How Math Practices 1–3 Help All Students Access Math Learning and Build Skills for the Future](#)

[Putting the Practices into Action: Implementing the Common Core Standards for Mathematical Practice, K-8](#)

[When does \$2 + 7 + 8 = 1\$? NCTM Ignite Talk](#)

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.



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1. Why did you choose to work on this micro-credential? (Include your own career goals and current teaching assignment.)
2. What is your experience with Math Practices?
3. Describe your student demographics.
4. What would you like your students to be able to do as a result of working on this micro-credential?

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 student may benefit.

Part 2. Work Examples/Artifacts/Evidence

To earn this micro-credential, please submit the following three artifacts as evidence of what you learned.

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

Artifact 1: Task Analysis

Choose a problem or task from a lesson that allows students to engage in Math Practice 1. Utilize the implementation characteristics identified under Math Practice 1 on [Achieve the Core's Implementing Standards for Mathematical Practices](#) to analyze the problem or task.

Task analysis must include:

- the problem or task
- the mathematics standard(s) addressed and any learning objectives/outcomes
- how the task addresses the implementation characteristics (in the bottom box)

Artifact 2: Student evidence 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 1. The samples must include the following:

- 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 2-4 minute video that shows you teaching and interacting with students for the task you analyzed in Artifact 1
Your video must include the following:



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- A verbal identification of at least one strength (either during the recorded conversation or in a voiceover)
 - Example: While working with your student(s) pause and say something like, "I am noticing that you are really good at _____."
- A verbal identification of at least one step you have taken 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----. I think 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 with instruments blocking students' faces and/or shoot video from the neck down. 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 (i.e., your Google Drive). Please make sure your sharing permissions are set to anyone with the link can view it. You can change this setting 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. The handout synthesizes how they can support students at home or at school, to make sense of mathematical problems and persevere in solving them. Your one-page handout needs to include:

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

Part 2. Rubric

| | Proficient | Basic | Developing |
|----------------------------------|--|--|---|
| Artifact 1: Task Analysis | The task analysis includes the following: <ul style="list-style-type: none"> ● The problem and task | The task analysis includes some of the following: <ul style="list-style-type: none"> ● The problem and task | The task analysis does not sufficiently include the following: <ul style="list-style-type: none"> ● The problem and task |



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| | | | |
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| | <ul style="list-style-type: none"> • The math standard(s), objectives, and outcomes • The Four Implementation Characteristics of Mathematical Practice 1 • How the task addresses the implementation characteristics | <ul style="list-style-type: none"> • The math standard(s), objectives, and outcomes • The Four Implementation Characteristics of Mathematical Practice 1 • How the task addresses the implementation characteristics | <ul style="list-style-type: none"> • The math standard(s), objectives, and outcomes • The Four Implementation Characteristics of Mathematical Practice 1 • How the task addresses the implementation characteristics |
| <p>Artifact 2: Student evidence from task</p> <p>Samples of Student Work Option</p> | <p>Student samples include all the following:</p> <ul style="list-style-type: none"> • Two samples displaying different levels of Math Practice 1 • 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 1 • 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 all:</p> <ul style="list-style-type: none"> • Two samples displaying different levels of Math Practice 1 • 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 Option</p> | <p>Videos include all the following:</p> <ul style="list-style-type: none"> • At least one strength | <p>Videos include some of the following:</p> | <p>Videos do not sufficiently include the following:</p> |



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| | <p>(either during the recorded conversation or in a voiceover)</p> <ul style="list-style-type: none"> At least one step toward proficiency for each student (either during the recorded conversation or in a voiceover) | <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 (either during the recorded conversation or in a voiceover) | <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 (either during the recorded conversation or in a voiceover) |
| <p>Artifact 3: One Page Handout</p> | <p>The one-page handout clearly shows how to support students to increase achievement in making sense of solving problems and persevering through them.</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 1 What students | <p>The one-page handout attempts to show how to support students to increase the achievement of making sense of solving problems and persevering through them.</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 1 | <p>The one-page handout does not show how to support students to increase the achievement of making sense of solving problems and persevering through them.</p> <p>It is missing three or more of the following:</p> <ul style="list-style-type: none"> Your intended audience (families, support professionals , or both) Explanation of Math Practice 1 |



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| | | | |
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| | <p>should be able to do (in language that students can understand)</p> <ul style="list-style-type: none"> • 2-3 questions and/or prompts to guide students through the process • What to do when a student is stuck • 1-3 resources/links to use at home, in a resource room, or in another location | <ul style="list-style-type: none"> • What students should be able to do (in language that students can understand) • 2-3 questions and/or prompts to guide students through the process • What to do when a student is stuck • 1-3 resources/links to use at home, in a resource room, or in another location | <ul style="list-style-type: none"> • What students should be able to do (in language that students can understand) • 2-3 questions and/or prompts to guide students through the process • What to do when a student is stuck • 1-3 resources/links to use at home, in a resource room, or in another location |
|--|---|---|---|

Part 3 Reflection

350-600 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 the following 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 1 impact how you approached this task? Describe any shifts in understanding for yourself and for your students.



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2. Reflect on your role in facilitating student learning regarding Math Practice 1 on this task. In your response, include specific details from student work and your feedback in Artifact 2.
3. What next steps might you take moving forward? How do you plan to 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 specific actionable steps that demonstrate how new learning will be integrated into future practices.



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