



Use Appropriate Mathematical Tools Strategically

Competency

Educators will engage and support students to use appropriate tools strategically.

Key Method

Educators will analyze student tasks and proficiency levels of the students to explain Mathematical Practices Standard 5, Using Appropriate Mathematical Tools Strategically, 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



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- 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.

Assessing Mathematics



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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

Use Appropriate Tools Strategically

Mathematically proficient students consider the available tools when solving a mathematical problem. These tools might include pencil and paper, manipulatives concrete models, a ruler, a protractor, a calculator, a spreadsheet, a computer algebra system, a statistical package, or dynamic geometry software. Proficient students are sufficiently familiar with tools appropriate for their grade or course to make sound decisions about when each of these tools might be helpful, recognizing both the insight to be gained and their limitations. For example, mathematically proficient students at all levels use manipulatives to model and solve problems. Additionally, they analyze graphs of functions and solutions generated using a graphing calculator or online graphing tool. They detect possible errors by strategically using estimation and other mathematical knowledge. When making mathematical models, they know that technology can enable them to visualize the results of varying assumptions, explore consequences, and compare predictions with data. Mathematically proficient students at various grade levels are able to identify relevant external mathematical resources, such as digital content located on a website, and use them to pose or solve problems. They can use technological tools to explore and deepen their understanding of concepts. (CCSS)

Mathematically proficient students should be able to:

- Consider the available tools when solving a mathematical problem. These tools might include:
 - pencil and paper
 - concrete models and manipulatives
 - a ruler
 - a protractor
 - a calculator
 - a spreadsheet
 - a computer algebra system
 - a statistical package
 - dynamic geometry software



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- Identify tools appropriate for their grade or course to make sound decisions about when each of these tools might be helpful, recognizing both the insight to be gained and their limitations
- Detect errors by strategically using estimation and other mathematical knowledge
- Know that technology can enable them to visualize the results of varying assumptions, explore consequences, and compare predictions with data
- Identify relevant external mathematical resources, such as digital content located on a website, and use them to pose or solve problems
- Use technological tools to explore and deepen their understanding of concepts

Assessing Mathematics

Assessing student learning in mathematics is vital to their progress and managing instruction. Ensure that assessments include these core components:

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

Teaching Strategies that Support Choosing and Applying Mathematical Tools

In mathematics education, empowering students to choose and apply appropriate mathematical tools is crucial. Some teaching strategies that support this are:

- Use concrete tools and manipulatives to model abstract problems.
- Have student thinking start with concrete models to build an understanding of abstract concepts.
- Use technology as a tool to explore multiple similar cases to build student understanding.

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*



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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.language magazine.com/mathematically-speaking/>

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

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](#)



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[Achievethecore.org: Instructional Content Nav - Mathematics: Focus by Grade Level](https://www.achievethecore.org/instructional-content-nav-mathematics-focus-by-grade-level)

[Deep Dive: How Math Practices 5 and 6 Build Student Confidence and Ownership of Their Learning](#)

[Math Ed Reports](#)

[Mathematics Standards](#)

[MP5 Examples](#)

[MP5 Use appropriate tools strategically](#)

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

[Standard 5: Use Appropriate Tools Strategically | Inside Mathematics](#)

[Standards for Mathematical Practice](#)

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

Assessment and Strategies for Mathematics

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

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

[Assessing Quantitative Reasoning](#)

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

[Talk moves](#)

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.



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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 own career goals and your current teaching assignment.)
2. What is your experience with Math Practices?
3. Describe your student demographics.
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 student may benefit.

Part 2. Work Examples/Artifacts/Evidence

To earn these micro-credentials please submit the following 3 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 5. Utilize the implementation characteristics identified under Math Practice 5 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 various levels of proficiency of Math Practice 5. 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



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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:

- Verbal identification of one strength (either during the recorded conversation or in a voiceover)
 - For example: While working with your student(s) pause and say something like, “I am noticing that you are really 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----. 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 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. 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 problems and persevere in solving them. Your one-page handout needs to include the following:

- Your intended audience: families, support professionals, or both
- Explanation of Math Practice 5
- What students should be able to do (in student language)
- 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 |
|--|-------------------|--------------|-------------------|



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| | | | |
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| <p>Artifact 1: Task Analysis</p> | <p>The task analysis includes all the following:</p> <ul style="list-style-type: none"> • The problem and task • The math standard(s) and objectives and outcomes • The Four Implementation Characteristics of Mathematical Practice 5 • How the task addresses the implementation characteristics | <p>The task analysis includes some of the following:</p> <ul style="list-style-type: none"> • The problem and task • The math standard(s) and objectives and outcomes • The Four Implementation Characteristics of Mathematical Practice 5 • How the task addresses the implementation characteristics | <p>The task analysis does not sufficiently include the following:</p> <ul style="list-style-type: none"> • The problem and task • The math standard(s) and objectives and outcomes • The Four Implementation Characteristics of Mathematical Practice 5 • 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 5 • 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 5 • 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 the following:</p> <ul style="list-style-type: none"> • Two samples displaying different levels of Math Practice 5 • 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>Videos include all the following:</p> <ul style="list-style-type: none"> • At least one strength | <p>Videos include some of the following:</p> <ul style="list-style-type: none"> • At least one strength (during | <p>Videos do not sufficiently the following:</p> |



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| <p>Video Option</p> | <p>(during the recorded conversation or in a voiceover)</p> <ul style="list-style-type: none"> At least one step toward proficiency for each student (during the recorded conversation or in a voiceover) | <p>the recorded conversation or in a voiceover)</p> <ul style="list-style-type: none"> At least one step toward proficiency for each student (during the recorded conversation or in a voiceover) | <ul style="list-style-type: none"> At least one strength (during the recorded conversation or in a voiceover) At least one step toward proficiency for each student (during the recorded conversation or in a voiceover) |
| <p>Artifact 3: One Page Handout</p> | <p>The one-page handout clearly shows how to help students use appropriate mathematical tools strategically.</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 5 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 | <p>The one-page handout attempts to show how to help students use appropriate mathematical tools strategically.</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 5 What students should be able to do (in a language students can understand I) Questions and/or prompts (2-3) to guide students through the process What to do when a student is stuck 5-3 Resources/links | <p>The one-page handout does not show how to help students use appropriate mathematical tools strategically.</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 5 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 (5-3) to use at home, in a |



| | | | |
|--|--|--|---------------------------------------|
| | <ul style="list-style-type: none"> • What to do when a student is stuck • Resources/links (5-3) to use at home, in a resource room, or in another location | (5-3) to use at home, in a resource room, or in another location | 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 5 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 5 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 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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