Teacher Guide to Implementing MC² Thinking Protocol for Mastery of Specific Common Core Content and Mathematical Practice Standards

Purpose	Activity	Materials
Part 1: Preparation during Professional Learning Community (PLC) **Why Math Practices?** The Common Core Mathematical Practice Standards describe varieties of expertise that math educators at all levels should seek to develop in their students. These practices rest on the following *processes and proficiencies* with longstanding importance in mathematics education. • **NCTM Process Standards:** Problem solving, reasoning and proof, communication, representation, and connections • **National Research Council's Report/Adding It Up Mathematical Proficiency Strands:** Adaptive reasoning, strategies competence, conceptual understanding, procedural fluency, and productive disposition	**1.** In a PLC or with a colleague, **develop or select a formative assessment task** to administer to students (item should be based on instruction that students are currently engaged in or have previously experienced in class). Curriculum resources or released PARCC test items are good sources for tasks. **2.** Choose a set of **Thinking/Writing Prompts** below based on the math practice the class is working to develop. The questions are intended to help students move beyond "answer getting" to fully making sense of test item questions and their own mathematical thinking to develop other indicators. **Math Practice 1: Make sense of problems and persevere in solving them.** • What do you know about the problem? • What questions do you have? • Explain your reasoning or thinking in solving the problem. **Math Practice 3: Construct viable arguments and critique the reasoning of others.** • What are the assumptions, definitions, and previous knowledge to help in thinking about this problem? • What are some possible conjectures that you have about the problem? • Explain your mathematical argument so that somebody else can make sense of your thinking. **Math Practice 4: Model with mathematics.** • What are the important quantities in the problem that are needed to solve it? • What mathematical operation(s) or representation(s) will you use to solve the problem? • Explain how you know your answer makes sense in the context of the situation. **Math Practice 6: Attend to precision.** • What are the important units in the problem? (What are you measuring or counting?) • What relationship between the units/quantities do you need to know in order to solve the problem? • Use appropriate and precise mathematical language, units, labels and computations to clearly describe your mathematical reasoning. **3.** Add the prompts to the practice item worksheet or display the prompts for the students to respond to. **4.** Continue using the same set of prompts for an extended period of time so children develop competence and confidence in describing their mathematical thinking related to the math practice.	**Rich math problems** aligned to CCSS-M (Open-ended tasks) **MC² PARCC Practice Test Item Packets** https://mc2.nmsu.edu/teachers/preparing-for-parcc/ **PARCC Released Items** https://parcc-assessment.org/released-items/?fwp_subject_facet=mathematics **PARCC Math Practice Tests** https://parcc.pearson.com/practice-tests/math/ **PARCC Answer Keys/Rubrics** https://parcc-assessment.org/answer-keys/ **Illustrative Mathematics** https://www.illustrativemathematics.org/content-standards

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Part 2: Administration of Task to Students **Why a task?** The intention of administering a task is to capture the journey of mathematical thinking and build a stronger understanding of mathematics through conversations. This takes effort and thought and doesn't always come out perfect the first time.	Set aside **at least 15-20 minutes of instructional time** for students to: **1. Think individually (3+ Minutes)**–Have students think about the problem alone, answer the set of *Math Practice Thinking/Writing Prompts* using one of the pencils. **2. Think with a partner (5+ Minutes)**–Have students share their solutions and responses to the *Thinking/Writing Prompts* with a partner. Using a different pencil or pen, they can change or add to their answers and/or add any new insights they learned. Remind students that no erasing is allowed. Make sure both partners have a chance to share. **3. Think with the class (6+ Minutes)**–Have students share different solution strategies and responses to the *Thinking/Writing Prompts* with the whole class. Summarize and record the different strategies used. The following sentence frames which promote the math practices may be used by the students: **Math Practice 3: Construct viable arguments and critique the reasoning of others** • I made a conjecture when I… • I justifies my conclusion by… • I constructed a viable argument when… • I made sense of another's argument when… • A question I asked to help clarify my own or someone else's thinking was… **Math Practice 4: Model with mathematics.** • The important quantities in this problem are ___ because ___. • I estimate the answer to be ___ because ___. • I decided to represent the problem by (table, equation, graph, diagram, flow-chart, formula, etc.) because ___. • The equation I used to represent the problem matches my mathematical thinking because ___. • I changed my strategy when ___. **Math Practice 6: Attend to precision.** • The explanation could be stronger if ___. • I examined ___'s claim and offered ___ to make it clearer. • We checked the accuracy of our calculations by ___. • I used ___ vocabulary in the anchor chart to make my communication precise. • We know the equal sign was used appropriately because ___. • In this problem, our symbols and variables represent ___. • The use of units helped me to make sense of the problem when __. **4. Reflect on the process (1+ Minutes)**–Have students reflect on the task and identify what was easy/hard about the problem. Additional reflection questions are available on the Student Reflection Form. **5. Collect and sort the student work** based on the rubric developed in the PLC. There is no need to score the work (alpha/ numeric/percent), only complete an initial sort.	**Copy of student task** for each student **2 pencils and/or pen** (each with different color lead/ink) for each student **For additional student reflection questions, go to the link below:** https://mc2.nmsu.edu/teachers/5-ways-to-implement/#4

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Part 3: Collaborative Reflection during PLC **Why reflect?** High levels of reflection are a practice that is best fostered with colleagues. It provides a good sense of when teachers need to step back and think deeply and promotes better understanding of what is/isn't working.	**1. Review student work and analyze** different solution strategies which students used to solve the problem. **2.** In a PLC, **discuss what data** this process/task provides. Consider what instructional strategies are needed to support students' development of Mathematical Practices and flexibility in problem solving. **a.** What do students understand? Where is the evidence in the student work? **b.** What were misconceptions/gaps in the students' knowledge? Where is the evidence in the student work? **c.** What were the instructional strategies or classroom experiences that can help move the learning forward? **d.** How can the protocol be used to build math confidence in students? **e.** How are the Common Core and Math Practice Standards advanced using the MC² Thinking Protocol as classroom warm-up problems?	**Student work** (Sorted based on rubric developed/selected in PLC during Part 1) **MC² Thinking Protocol Data Collection & Analysis Tool** https://mc2.nmsu.edu/teachers/5-ways-to-implement/#4