



MC² Implementation Framework/Teacher Practices

What are the instructional strategies needed to support mathematics teaching for student learning every day?

	GROWTH MINDSET	STANDARDS-BASED LEARNING ENVIRONMENT (SBLE)	LAUNCH-EXPLORE-SUMMARY (Lesson Model)	DISCOURSE & QUESTIONING	NUMBER TALKS
WHAT IT IS	<p>A <i>growth mindset</i> stresses that success and learning in mathematics are a reflection of effort and not intelligence alone, and thus promotes a belief that all students are capable of participating and achieving in mathematics. Encouraging the development of student growth mindsets in the classroom situates mathematics teaching and learning as processes that cultivate mathematical abilities</p> <p>Boaler 2011; Dweck 2006 PtA, p. 64-65</p>	<p><i>SBLE</i> is a learning environment in which the classroom culture is established through purposeful routines that support full student engagement in rich mathematical reasoning and student discourse. These routines provide a structure for accessing student voice and knowledge while building both conceptual and procedural understanding of important math concepts. The SBLE is a student-centered classroom where students and teachers understand the value of thoughtful problem-solving, sharing multiple perspectives, and peer interactions to build profound and flexible math understanding.</p>	<p>LES is a problem-centered instructional model that opens the mathematics classroom to exploring, conjecturing, reasoning, and communicating. This model is very different from the “transmission” or “direct instruction” model, in which teachers tell students facts and demonstrate procedures and then students memorize the facts and practice the procedures. The LES model looks at instruction in three phases: launching, exploring, and summarizing.</p> <p>In the LES lesson model the teacher has a critical responsibility for ensuring that students abstract and generalize the important concepts and procedures from their own experiences exploring rich mathematics problems. This necessitates that teachers take on new roles: they move from always being the one who does the mathematics to being the one who guides, questions, and facilitates the student learner to do and make sense of the mathematics from their own experiences.</p>	<p>Effective teaching of mathematics requires teachers to facilitate discourse among students to build shared understanding of mathematical ideas by analyzing and comparing student approaches and arguments.</p> <p>Teachers use the way students talk about-think about-represent their math ideas to craft mathematics learning for all students. Student discourse about mathematics is what drives the learning connections in the classroom.</p> <p>Teachers must be skilled in high-leverage instructional practices that improve the quality of the discussions we have about math in our classrooms (e.g., talk moves, questioning, using student thinking, supportive environment and facilitating discourse).</p>	<p>A <i>Number Talk</i> is a teacher-facilitated conversation and discussion, conducted daily in no more than fifteen minutes about a purposefully chosen model or problem where the computation is solved mentally. The focus is not on the correct answer, rather on student thinking, various efficient strategies, and mathematical connections.</p> <p>In <i>Number Talks</i>, students listen to other students’ strategies, and as they look for relationships among different solutions, their mathematical understanding is deepened. It is through the investigation of the diverse ways of seeing and solving problems that students develop a robust understanding of mathematics.</p> <p>Students need opportunities to think and learn to solve problems in ways that make sense to them.</p>

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WHY IT MATTERS FOR STUDENT LEARNING	<p>Teachers' beliefs influence the decisions that they make about the manner in which they teach mathematics... Students' beliefs influence their perception of what it means to learn mathematics and their dispositions toward the subject. – PtA, p. 9-10</p> <p>Students, parents, and teachers often hold unproductive beliefs/mindsets about: who can learn mathematics, who should have access to mathematics, and how to teach mathematics. These unproductive beliefs limit student growth in mathematics learning and achievement. – PtA, p. 62</p> <p>Therefore, it is essential for teachers to be aware of how their own mindsets can influence the mathematical identities – present and future – of their students. “Believing in, and acting on, growth mindsets versus fixed mindsets can make an enormous difference in what students accomplish.” – PtA, p. 64-65</p>	<p>Research (TARR) found that classroom environment and discourse have a great impact on students' math learning. When the classroom environment fosters the following five observable traits, student learning increases for all learners in the classroom.</p> <ul style="list-style-type: none"> • Lessons provide opportunities for students to make conjectures about mathematical ideas. (Engaging preconceptions / prior understanding, NRC) • Lessons foster the development of conceptual understanding. (PtA, NRC) • Students explain their responses or solution strategies. (MTP #4, #8) • Multiple perspectives/strategies are encouraged and valued. (MTP #2, #4, and #8) • The teacher values students' statements about mathematics and uses them to build discussion or work toward shared understanding for the class. (MTP #4, #7, #8) 	<p>The Launch-Explore-Summary (LES) lesson model supports multiple research findings about how student learn mathematics:</p> <ul style="list-style-type: none"> • Engage with challenging tasks that involve active meaning-making and support meaningful learning; • Connect new learning with prior knowledge and informal reasoning and, in the process, address preconceptions and misconceptions; • Acquire conceptual knowledge as well as procedural knowledge, so that they can meaningfully organize their knowledge, acquire new knowledge, and transfer and apply knowledge to new situations; • Construct knowledge socially through discourse, activity, and interaction related to meaningful problems; • Receive descriptive and timely feedback so that they can reflect on and revise their work, thinking, and understanding; and • Develop meta-cognitive awareness of themselves as learners, thinkers, and problem-solvers, and learn to monitor their learning and performance. – PtA, p. 9 	<p>Discourse (MTP #4)</p> <ul style="list-style-type: none"> • Students have so many wonderful things to say! We need to get out of the way and let them say it. Student learning is strengthened when they make connections between their thinking and that of other students. Discourse that focuses on tasks that promote reasoning and problem solving is a primary mechanism for developing conceptual understanding and meaningful learning of mathematics. – PtA, p. 30 • Students who learn to articulate and justify their own mathematical ideas, reason through their own and others' mathematical explanations, and provide a rationale for their answer develop a deep understanding that is critical to their future success in mathematics and related fields. – PtA, p. 30 <p>Questioning (MTP #5)</p> <ul style="list-style-type: none"> • “Questions are important in learning about student thinking, challenging conclusions, and extending the inquiry to help generalize patterns. If you don't ask students to think, they aren't going to. While this might sound simple, questioning is actually very complex and something that effective teachers continue to improve throughout their career.” – VDW, p. 51 • Effective mathematics teaching relies on questions that encourage students to explain and reflect on their thinking as an essential component of meaningful mathematics discourse. – PtA p. 35 	<ul style="list-style-type: none"> • Make sense of mathematics and develop flexibility with numbers • Develop computational fluency • Improve mental computation skills (MTP #6) • Reason and defend solutions and develop mathematical language • Understand number relationships which are foundational to success in Algebra (MTP #3 & #4) • Recognize and adopt multiple strategies for the same problem (MTP #2) • Think deeply about their own mathematical processes in order to share strategies with the class. • Apply Growth Mindset statements and strategies to support their own math identities, self-confidence and perseverance skills. (MTP #7 & #8)

Research Cited:

- PtA = *Principles to Actions*, NCTM, 2014
- MTP = Math Teaching Practices from *Principles to Actions*
- NRC = *How Students Learn Mathematics*, National Research Council, 2004
- VDW = *Teaching Elementary and Middle School Mathematics*, John Van de Walle, 8th ed., 2012
- TARR = Tarr, J.E., Reys, R.E., Reys, B.J. & Chávez. O. (2008). “The Impact of Middle-Grades Mathematics Curricula and the Classroom Learning Environment on Student Achievement.” *Journal for Research in Mathematics Education*, Vol. 39, No. 3, pp. 247-280