Lesson Structure & Practices for Teaching *Through* Problem Solving

	LEDS Lesson Structure (Similar to W2.0)		**The 5 Practices for Orchestrating Productive Math Discussions**
Before Lesson	Plan for access, challenge, and equitable participation during the launch, explore, discussion, and synthesis		0 - Learning Targets & Selecting Tasks 1 - Anticipate Student Thinking
During Lesson	**Launch**	All students have access to the context of the problem, expectations for how to work, and/or why you are engaging in the work	
	***Explore**	**Students grapple independently and/or collaboratively**	2 - Monitor 3 - Select 4 - Sequence
	***Discuss**	Student work is analyzed and discussed as a class. The teacher plays a critical role in making thinking visible (boardwork), active engagement strategies, and questioning.	5 - Connect student ideas to the learning target and/or to each other
	Synthesize	The teachercs of the lesson through questioning and making thinking visible (boardwork).	5 - Connect student ideas to the learning target and/or to each other
	Reflect, Apply, Assess	Students reflect on their understanding of the learning target and work is collected to assess student knowledge and skills related to target	Student work is analyzed and used to anticipate student thinking and monitoring questions for upcoming lessons.

*It should be noted that the Explore and Discuss phases might happen once in sequence during a lesson or multiple times, depending on what aspects of the task(s) need to be discussed and understood by the entire class.

Launch, Explore, Discuss, Synthesize (LEDS) Lesson Structure	
Hot Tips and Tools	• Anticipatory Framework Math Grapple Lesson Plan Template • A teacher may use one or multiple Explore and Discuss phases in a single lesson. This can be especially useful at the secondary level when teachers have two or three questions or parts of a task that might build on each other. • Hot Tips for Discourse • Teaching for Understanding • Implementing Standards for Mathematical Practice
Component	**Description**
Anticipatory Framework	• Look at student work/examine previous learning to identify your math understanding goals for the lesson • Choose a high-level task that aligns with your math understanding goals • **Anticipate** student responses by solving the problem in ways you expect students to solve the task and prepare questions to assess and advance their thinking • Plan for how you hope to connect student thinking through anchor charting/board organization (example) • Plan for access and equitable interaction during the lesson ○ What manipulatives or materials may support students who decide to create a physical or visual model?
Launch (5-10 min)	• Introduce the task in a way that provokes students' curiosity and need to know linked to the purpose of the lesson • Introduce the task in a way that creates access for every student • Teachers may choose to reveal the learning target during this portion or hold it to reveal during synthesis
Explore (5-20 min)	• Anchor to norms for individual and/or group grapple time • Students grapple independently and/or collaboratively with the task • **Monitor**: Teacher circulates the room and monitors student thinking and collaboration (if applicable). Teacher confers with students using a neutral stance to assess and advance their thinking. Teacher conferrs strategically and never to take student thinking (telling students what to do to solve the problem.) • **Select and Sequence:** As the class moves from exploration to the whole class discussion, the teacher chooses student student methods to share that highlight key mathematical ideas that will help achieve the learning target and

	sequences in an order that creates a coherent storyline and student access for the lesson.

Discussion
(10-15 min)
	● Anchor to whole class discussion norms
	● Teacher poses a question/ thinking job for all students to consider
	● 2-3 students share their method with class - this might take happen in different ways, for example:
	    ○ Student verbal shares their method and the teacher charts on anchor chart or board
	    ○ **Connect**: Class analyzes student work using a document camera or gallery walk if using Vertical Non-Permanent Surfaces (VNPSs)
	● **Connect**: The teacher plays a critical role in drawing out connections between student methods and the learning target through questioning and anchor charting/boardwork

Synthesize (2-3 min)	● The teacher supports students to reflect on and synthesize what the class learned as a result of the lesson. The teacher records the lesson summary on an anchor chart or the board. Students have opportunities to reflect on what they individually learned as a result of the lesson.

Reflect, Apply, Assess
(5-15 min)
	● Provide students an opportunity to summarize what they learned individually and if time permits in this lesson, apply their learning (to improve their original work, try a new strategy for the same problem, or try a related problem(s)).
	● Example reflection prompts:
	    ○ Record one of the strategies from a classmate today that you are most interested in. Describe what you find interesting about the strategy.
	    ○ What did you learn today? What do you wonder about?
	    ○ How did your ideas change?
	    ○ What method used by a classmate do I want to try? Describe their method and why you want to try it.
	    ○ Let's return to our work from before. What might you add? What might you change?
	    ○ In your journal, write about what you notice is similar and different about the strategies we discussed. Then, try this similar but different problem using a method you want to try from our discussion.

5 Practices Overview

<table>
<tr><td colspan="2" rowspan="2">Practices that take place while planning for instruction</td><td>Practice 0: Setting goals and selecting tasks
Specifying learning goals and choosing a high-level task that aligns with those goals</td></tr>
<tr><td>Practice 1: Anticipating student responses
Exploring how you expect students to solve the task and preparing questions to ask them about their thinking.</td></tr>
<tr><td rowspan="4">Practices that take place during instruction but are considered while planning</td><td>Students work individually or in small groups</td><td>Practice 2: Monitoring student work
Looking closely as students work on the task and asking questions to assess their understanding and move their thinking forward.</td></tr>
<tr><td rowspan="2">As you move from small group work to whole class discussion</td><td>Practice 3: Selecting student solutions
Choosing solutions for students to share that highlight key mathematical ideas that will help you achieve lesson goals.</td></tr>
<tr><td>Practice 4: Sequencing student solutions
Determining the order in which to share solutions to create a coherent storyline for the lesson</td></tr>
<tr><td>Whole class discussion</td><td>Practice 5: Connecting student solutions
Identifying connections among student solutions and to the goals of the lesson that you want to bring out during the discussion.</td></tr>
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Source & Anchor Texts: The 5 Practices in Practice by Margaret (Peg) Smith, Miriam Gamoran Sherin, Miriam Gamoran Sherin, and Michael D. Steele (elementary, middle, and high school editions available)

Teaching for Understanding Excerpts

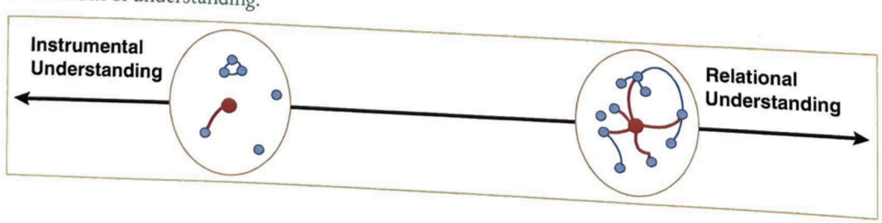
Teaching Student-Centered Mathematics

Teaching for Understanding

"Teachers generally agree that teaching for understanding is a good thing. But what do we mean by *understanding*? Understanding is being able to flexibly think about and use a topic or concept. It goes beyond knowing; it is more than a collection of information, factors, or data. It is more than being able to follow steps in a procedure. One hallmark of mathematical understanding is a student's ability to justify why a given mathematical claim or answer is true or why a mathematical rule makes sense (CCSSO, 2010). Although students might know their basic multiplication facts and be able to give you quick answers to questions about these facts, they might not *understand* multiplication. They might not be able to justify how they know an answer is correct or provide an example of when it would make sense to use a particular basic fact. These tasks go beyond simply knowing mathematical facts and procedures. Understanding must be a primary goal for all of the mathematics you teach.

Understanding exists along a continuum (Fig 1.3) from an instrumental understanding – doing or knowing something without meaning – to a relational understanding – knowing what to do and why. These two terms were introduced by Richard Skemp in 1978 and continue to provide an important distinction about what is important for students to know about mathematics. Instrumental understanding, at the left end of the continuum, shows that ideas (eg. concepts and procedures) are learned, but in isolation (or nearly so) to other ideas. Here you find ideas that have been memorized. Due to their isolation, poorly understood ideas are easily forgotten and are unlikely to be useful for constructing new ideas. At the right end of the continuum is relational understanding. Relational understanding means that each new concept or procedure (red dot) is not only learned, but is also connected to many existing ideas (blue dots), so there is a rich set of connections.

Figure 1.3
Continuum of understanding.



The common notion of quickly "covering the material" and moving on is problematic when trying to help children develop relational understanding. Relational understanding is an end goal – that is, it is developed over time by incorporating active learning through the process standards and mathematical practices and striving toward mathematical proficiency. Therefore, relational understanding must be a goal for both daily and long-term instruction (Van de Wall et al., 2018, pp 7)."

Van de Walle, J. Bay-Williams, J, Lovin, L, & Karp, K. (2018). Teaching Student-Centered Mathematics.

Mathematical Mindsets

Case 3. A Time to Tell

"When I share open, inquiry-based mathematics tasks with teachers, such as the growing shapes or "raindrop" task just discussed, they often ask questions such as, "I get that these tasks are engaging and create good mathematical discussions, but how do students learn new knowledge such as trig functions? Or how to factorize? They can't discover it." This is a reasonable question, and we do have important research knowledge about this issue. It is true that while ideal mathematical discussions are those in which students use mathematical methods and ideas to solve problems, there are times when teachers need to introduce students to new methods and ideas. In the vast majority of mathematics classrooms, this happens in a routine of teachers showing methods to students, which students then practice through textbook questions. In better mathematics classrooms, students go beyond practicing isolated methods and use them to solve applied problems, but the order remains – teachers show methods, then students use them.

In an important study, researchers compared three ways of teaching mathematics (Schwartz & Bransford, 1998). The first was the method used across the United States: the teacher showed methods, the students then solved problems with them. In the second, the students were left to discover methods through exploration. The third was a reversal of the typical sequence: the students were first given applied problems to work on, even before they new how to solve them; then they were shown the methods. It was this third group of students who performed at significantly higher levels compared to the other two groups. The researchers found that when students were given problems to solve, and they did not know methods to solve them, but they were given opportunity to explore the problems, they become curious, and their brains were primed to learn new methods, so that when teachers taught the methods, students paid greater attention to them and were more motivated to learn them. The researchers published their results with the title "A Time for Telling," and they argued that the question is not "Should we *tell* or explain methods?" but "When is the best time to do this?" Their study showed clearly that the best time was after students had explored the problems (Boaler, p. 66)."