Brief 4:

High-Leverage Instructional Practices

Supporting Evidence-Based P–12 Mathematics Teaching Practice

Produced for the New York State Education Department
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> No in-school intervention has a greater impact on student learning than an effective teacher.
>
> (National Council for Accreditation of Teacher Education, 2010, p. 1)

What is meant by “high-leverage instructional practices?”

High-leverage instructional practices (TeachingWorks, 2012) are essential to the work of teaching. When they are used with care and judgment, they are key to supporting students’ learning and thriving. Some familiar examples include **eliciting and interpreting individual students’ thinking, explaining and modeling content, leading a group discussion, setting up and managing small group work**, and **establishing and maintaining community expectations.** High-leverage instructional practices are grounded in research on teaching and learning mathematics and support students’ mathematics learning and development.

These instructional practices help students learn important mathematical content and practices. They are also crucial in promoting equity and inclusion in the classroom, and they enable teachers to support students’ social and emotional development.

Eliciting and interpreting individual students’ thinking (sometimes referred to as “posing questions”)

Teaching mathematics well depends on understanding students’ thinking. This high-leverage practice focuses on surfacing novel points of view, new ideas, and ways of thinking, as well as alternative conceptions. Through this, teachers draw out student thinking using carefully chosen questions and tasks followed by attending closely to what students do and say. Teachers can use what they learn about students to guide instructional decisions, and to surface ideas for the class to consider. Eliciting and interpreting student thinking positions students as sense-makers and centers their thinking as valuable.

Questions asked during mathematics teaching should move beyond eliciting only answers and processes. Studies show that students whose teachers elicit (and listen to) their thinking more frequently outperform their peers in classrooms where teachers elicited thinking less frequently. Students need to have opportunities to articulate, explain, provide detail about, and justify their strategies and thinking. Questions that elicit this level of thinking are also tied to increased student engagement and learning.

Spotlight on Practice

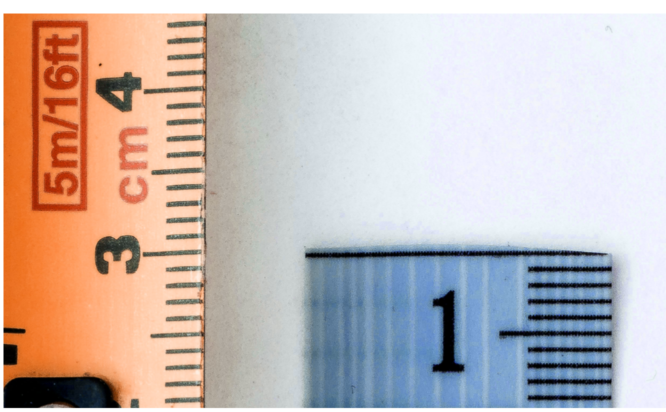
Randy is a four-year-old multilingual learner who is enthusiastic about playing math games with his teacher, Mr. Gonzalez, during center time. While exploring manipulatives, Mr. Gonzalez asks Randy questions like, “how many are there?” and follows up by asking, “how do you know?” Mr. Gonzalez notices and interprets Randy’s nonverbal communications and uses them to draw out his thinking, e.g., “I saw you moving your fingers, what were you doing?” He also narrates his own thinking, modeling the kinds of explanations Randy might learn to give, e.g., “I saw two and one and I know that makes a group of three!” Over time Mr. Gonzalez learns that Randy successfully uses his fingers to count and has mastered one-to-one correspondence to 10 (matches one number word to one object while counting). By demonstrating a genuine interest in his mathematical thinking, Mr. Gonzalez communicates to Randy that his ideas are fascinating and important, bolstering Randy’s developing mathematical identity.

Explaining and modeling content (sometimes called "cognitive apprenticeship")

Explaining and modeling are practices for making a wide variety of topics, academic practices, and strategies explicit to students. When teachers explain or model, it can help make visible content and practices that are otherwise tacit, such as which definition of subtraction you are using to solve a problem on the number line. Teachers might use simple explanations when working with straightforward content. They might choose modeling, which includes verbal explanation as well as thinking aloud and demonstrating when sharing the metacognitive process, to provide greater access to students about strategies and practices.

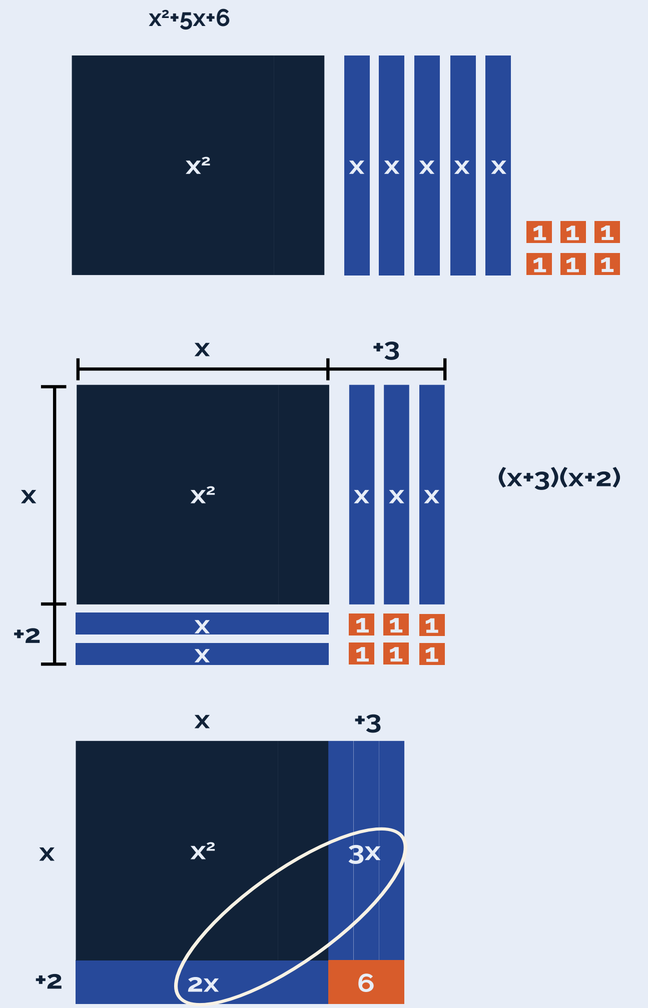
This is different from what people sometimes call "direct instruction" because it builds on the idea that students are sense-makers, not empty vessels to be filled. It also maintains the cognitive demand, ensuring that students are engaging with rich academic content. Explaining and modeling in mathematics often involve the use of manipulatives and representations. These are central resources in mathematics teaching and take special care to support student learning; therefore, the use of manipulatives and representations is outlined in a separate brief (Brief #6).

Explaining and modeling in mathematics is often an instructional practice used to support students in approaching "word problems." Modeling for students how to identify the mathematical structure underlying the word problem (e.g., combining) can support students in representing and solving word problems. Research has shown this can be more effective than other strategies for supporting students with disabilities, such as identifying keywords. The goal should be for the teacher to be aware of different problem types, ensure students are engaged in a variety of problem types, and support them in naming the key concepts (combining, comparing, grouping, etc.) as a framework for problem solving. Modeling serves as a scaffold for this process—not the teacher's opening instructional move. For more information on problem structures in mathematics, see the Common Addition and Subtraction Situations in the [New York State Next Generation Mathematics Learning Standards.]



Spotlight on Practice

Ms. Jackson's high schoolers have typically learned the procedure for factoring trinomials but seem to lack the foundational conceptual understanding that factoring is rewriting the expression as multiplication. She knows that students learned to represent multiplication using an area model in elementary school and found areas of geometric figures in middle school. She decides to help them connect the process of factoring to multiplication area models. She begins by showing the terms of the trinomial with algebra tiles and rearranging them to create a rectangle (process shown below). She then supports them to name the length of the sides of the rectangle and connects this representation to the factors of the trinomial. Finally, she connects algebra tiles to area models, walking her students through the process of mapping the terms of a trinomial onto the area model and considering how to determine the factors. She describes the process while narrating her thinking at each stage, and carefully documenting her modeling visually on the board. In this way, she is able to help students "see" what may be less visible and to engage with important academic content in ways that are grounded in meaning.



Leading a group discussion

In a group discussion, the teacher guides students as they work together on specific content, using one another's ideas as resources. The purposes of a discussion are to build collective knowledge and capability in relation to specific instructional goals and to allow students to practice listening, speaking, interpreting, questioning, agreeing, and disagreeing. The teacher takes care to use a variety of strategies, including posing questions, showing, providing clarification, and orienting students to one another. The teacher supports a wide range of students to contribute orally, listen actively, and respond to and learn from others' contributions. Teachers work to ensure students are positioned as competent among their peers, that patterns of interaction are respectful, and that the collective work of the group uses students' strengths and benefits each student's learning.

Spotlight on Practice

Mr. Nguyen's second graders have been engaging in number talks. At first, Mr. Nguyen merely implements them as written (he gives his students an equation to solve mentally, collects solutions, then collects strategies). Mr. Nguyen begins to realize that there is an untapped opportunity for his students to experience the value of working collaboratively. He practices a more intentional "launch," where he explains to students that a number talk helps us work on efficiency, flexibility, and accuracy and that a new goal will be to learn a strategy from a friend. He orients students to one another's thinking by asking them to restate each other's strategies, supporting them to ask each other questions, and helping them see connections across strategies as he records and represents the thinking that gets shared on the board. These moves enable him to find authentic opportunities to position each student, especially those from historically marginalized groups, as smart in math. Over time, he sees evidence of many students "trying on" the strategies of others, and they eagerly look forward to engaging in number talks.

> Teachers and researchers alike know that engaging students in productive discussions can support the building of collective knowledge as well as individual students' understanding of mathematics (O'Connor et al., 2017; Franke et al., 2015). What students see and can collectively make use of in the public space of a classroom can support their engagement and learning in a discussion.
>
> (Garcia et al., 2021, p.927)

Standards for Mathematical Practice

Construct viable arguments and critique the reasoning of others

Mathematically proficient students . . . justify their conclusions, communicate them to others, and respond to the arguments of others . . . Students at all grades can listen or read the arguments of others, decide whether they make sense, and ask useful questions to clarify or improve the arguments (New York State Department of Education, 2019, p. 7).

Setting up and managing small group work

In order to set up and manage small group work, teachers choose tasks that require and foster collaborative work, provide clear directions that enable groups to work independently, and hold students accountable for collective and individual learning. Teachers use their own time strategically, deliberately choosing which groups to work with, when to work with them, and on what. They work to ensure students are positioned as competent among their peers, that patterns of interaction are respectful, and that the collective work of the group uses the strengths of and benefits each student.

Spotlight on Practice

Mx. Yazzie has given their fifth graders a complex problem, The Train Problem, to work on. While they could have students work on it independently, they see an opportunity to support cooperation and collaboration by assigning them to work in small groups. Mx. Yazzie considers the academic, social emotional, and language needs of each student, taking care to balance the groups in terms of intersecting identities. Before the groups begin working, Mx. Yazzie ensures that the task is clear and that students know what the various roles within the group are—e.g., someone should take notes, someone should be sure that everyone gets to share their idea, etc. As students are working, Mx. Yazzie circulates around the room, spending more time in groups that seem to need support and scaffolding. When they come back together, Mx. Yazzie shares some comments about how groups worked together and makes explicit the value of working collaboratively so that students understand that this is part of what gets worked on in class.

Establishing and maintaining community expectations

Teachers must set and maintain expectations and establish classroom environments that are productive and safe while also ensuring students' dignity. The NYSED Culturally Responsive-Sustaining Education Framework describes such environments as "a space where people can find themselves represented and reflected, and where they understand that all people are treated with respect and dignity. The environment ensures all cultural identities . . . are affirmed, valued, and used as vehicles for teaching and learning" (New York State Education Department, 2018, p. 14). To create this environment, teachers must carefully consider the purpose and impact of management routines. For example, some routines are aimed at supporting students' learning while others merely exercise control. Discerning the difference matters for creating learning environments that welcome learners and develop positive mathematical identities and competence. Classroom norms and agreements can be developed collaboratively with students. Such norms should emphasize the development of students' agency and responsibility for their learning, mutual respect, and collective engagement in the mathematical work. Agreements should also explicitly include how these norms will be maintained within the classroom community. This classroom environment should also support students to engage in challenging mathematics.

Principle #2 from the Four Principles of Culturally Responsive-Sustaining Education

High expectations and rigorous instruction prepare the community for rigor and independent learning. The environment is academically rigorous and intellectually challenging, while also considering the different ways students learn. Instruction includes opportunities to use critical reasoning, take academic risks, and leverage a growth mindset to learn from mistakes. Messages encourage positive self-image and empower others to succeed.

What do high-leverage instructional practices have to do with mathematical identity?

High-leverage instructional practices help teachers support students to broaden their understanding of what it means to do math well. This ensures that all students have opportunities to demonstrate their mathematical brilliance (Martin, 2007; Gholson, 2013).

Historically, not all children have had this opportunity—so high-leverage instructional practices are particularly important for students from "nondominant ethnic, racial, cultural, and language backgrounds, students with varying disabilities, and students from economically challenged areas" (Wilkerson, 2020).

When choosing which high-leverage instructional practices to use, consider the following factors (not exhaustive):

- **Content and learning goals**
- **Grade level**
- **Common patterns of student thinking**
- **Language needs of students**

Reflect & Analyze:

1. How and when do you decide to use different approaches to teaching mathematics—e.g., eliciting and interpreting individual students' thinking, modeling and explaining content, setting up and managing small group work, and leading a group discussion?

2. What practices do you find yourself using most often? Which ones do your curricular materials recommend the most? Do these align with what we know about student learning outcomes?

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