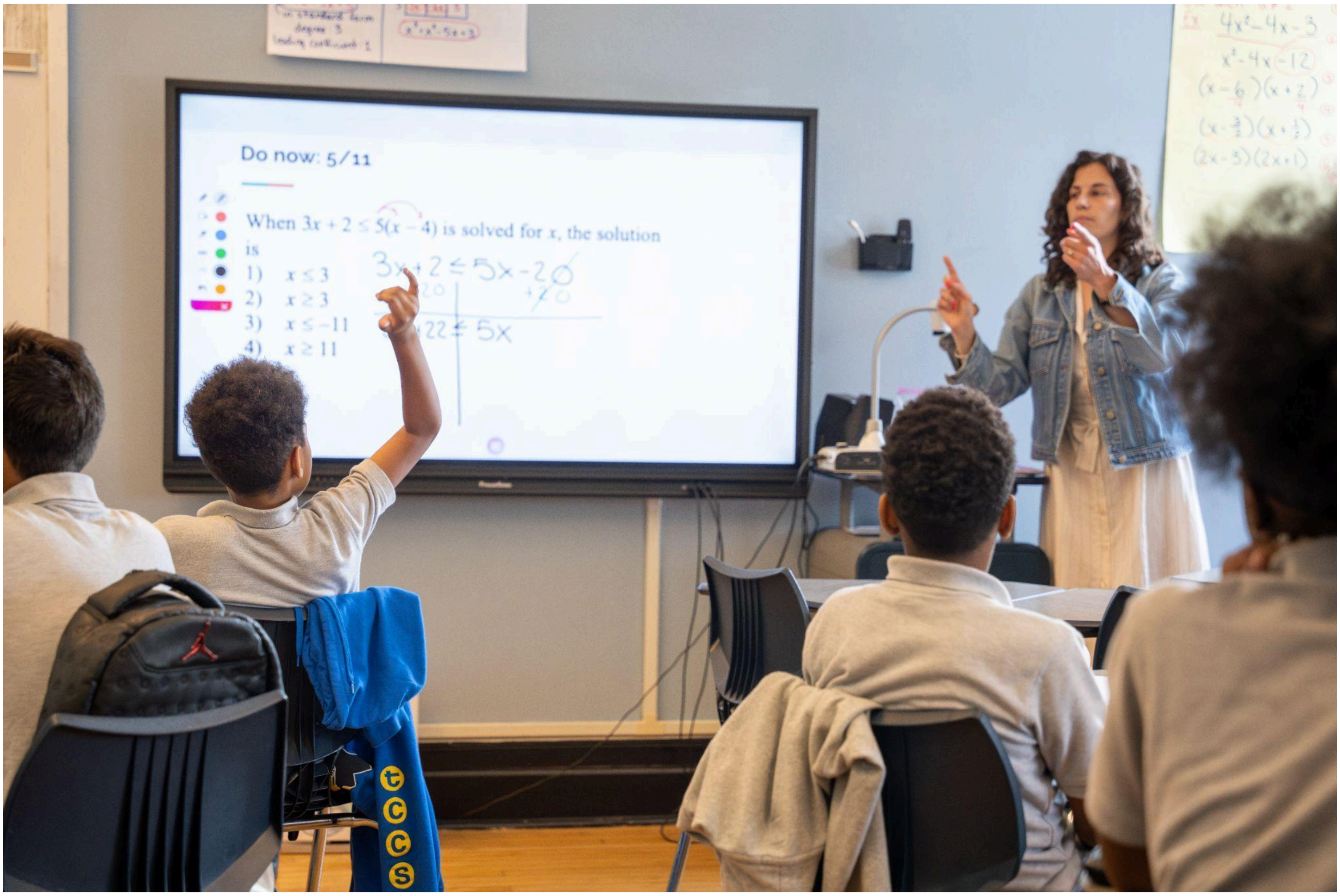
Explicit Instruction in Mathematics



Explicit Instruction Overview

All students are capable of and entitled to a rigorous, grade-level mathematics education, as described in the NYCPS Mathematics Instructional Shifts. Advancing students' abilities to engage in this kind of meaningful and sustaining mathematics learning requires a different kind of instruction from what many NYCPS students and teachers may have experienced in the past. For many years, NYCPS teachers have used a gradual release of responsibility approach to math instruction ("I do, we do, you do"), where responsibility for answering mathematical problems moves from teachers to students over the course of a lesson. The ways we have traditionally taught have not yielded the results we hope for. The majority of middle and high school students are not meeting grade level proficiency in math. Students of color, our students living in poverty, our students with disabilities and our multilingual learners are scoring well below our citywide average.

Adapting our practice to provide students with shifts-aligned mathematics instruction is not a simple change, but rather an adaptive one that requires ongoing support and collaboration, and will result in a diverse population of NYCPS graduates empowered to be independent doers of mathematics as opposed to mere answer getters. While it requires time, support and hard work, NYCPS teachers are committed to making this change in order to support their students become confident and capable *do-ers of mathematics*.

Historically, explicit instruction has been intertwined with the gradual release lesson structure. In fact, explicit instruction is a powerful teaching strategy that can be used effectively in a variety of different lesson structures. This document describes ways in which explicit instruction can be used in alignment with the NYCPS math instructional shifts.

The use of explicit instruction in the gradual release lesson structure involves using components of EI to introduce a specific concept or procedure in a highly structured and carefully sequenced manner. In the short term, this use can be effective in helping students answer mathematical questions more quickly; however, this introduction of new procedures through gradual release may slow the progress of students with disabilities and students who are not yet on grade level in becoming resilient, persistent problem solvers and developing deep conceptual understanding of topics.[1] This document discusses only gradual release in mathematics and is not intended to be applied in other content areas.

This guidance document supports educators in deepening their understanding of how explicit instruction is interwoven into the fabric of the NYCPS K-12 Mathematics Shifts. Connections are outlined below between the role of explicit instruction and how it shows up in shifts-aligned instruction through the examination of sample lesson activities from high quality instructional materials used in NYCPS math classrooms.

[1]Hord, C.; Newton, J.A. Investigating Elementary Mathematics Curricula: Focus on Students with Learning Disabilities. *Sch. Sci. Math.* **2014**, *114*, 191–201.

What does Shifts-Aligned Math Instruction mean?

Shifts-aligned math instruction involves implementation of a high-quality curriculum aligned to the NYCPS K-12 Mathematics Shifts. This instructional model moves away from teaching mathematics as a series of memorized established procedures to teaching mathematics as a discoverable, meaningful, and connected collection of big ideas and disciplinary practices.

NYCPS K-12 MATHEMATICS SHIFTS		
Shifts	**From**	**To**
1	Beginning with modeling	**Beginning with sensemaking**
2	Different tasks based on prior performance	**Shared, Low-floor, High-ceiling Tasks**
3	Discourse to demonstrate understanding	**Discourse to develop understanding**
4	Deficit-based support	**Asset-based support**
5	Using lesson materials from a variety of sources	**Shared High-Quality Instructional Materials**

NYCPS's mathematics shifts build on long-accepted research about how students learn mathematics and the instructional practices that support that learning. This includes the process standards of problem-solving, reasoning, communication, representation, and connections described by the National Council of Teachers of Mathematics and the five strands of mathematical proficiency described by the National Research Council.

Oftentimes, students with disabilities - as well as those with difficulties learning mathematics - are offered a more procedural mathematics when compared to their peers.[2,3] The documented positive outcomes of an inquiry approach to math, not only in building math knowledge,[4,5,6,7] but also in developing student identities as agentic problem-solvers with a positive relationship towards mathematics,[8,9] mean that all students benefit from shifts-aligned instruction.

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[2]Weiss, I.R.; Pasley, J.D.; Smith, P.S.; Banilower, E.R.; Heck, D.J. *Looking Inside the Classroom: A Study of K-12 Mathematics and Science Education in the United States*; Horizon Research Inc.: Chapel Hill, NC, USA, 2003.
[3]Jackson, H.G.; Neel, R.S. Observing mathematics: Do students with EBD have access to standards-based mathematics instruction? *Educ. Treat. Child.* **2006**, *29*, 593
[4]Boaler, J. *Experiencing School Mathematics: Traditional and Reform Approaches to Teaching and Their Impact on Student Learning*; Lawrence Erlbaum: Mahwah, NJ, USA, 1997.
[5]Boaler, J.; Staples, M. Creating mathematical futures through an equitable teaching approach: The case of Railside School. *Teach. Coll. Rec.* **2008**, *110*, 608–645.
[6]Carpenter, T.P.; Fennema, E.; Franke, M.L.; Levi, L.; Empson, S.B. Cognitively Guided Instruction: A Research-Based Teacher Professional Development Program for Elementary School Mathematics. Research Report; ERIC, 2000. Available online: **https://files.eric.ed.gov/fulltext/ED470472.pdf**
[7]Silver, E.A.; Stein, M.K. The Quasar Project: The "revolution of the possible" in mathematics instructional reform in urban middle schools. *Urban Educ.* **1996**, *30*, 476–521.
[8]Boaler, J.; Selling, S.K. Psychological Imprisonment or Intellectual Freedom? A Longitudinal Study of Contrasting School Mathematics Approaches and Their Impact on Adults' Lives. *J. Res. Math. Educ.* **2017**, *48*, 78–105.
[9]Horn, I.S. Turnaround students in high school mathematics: Constructing identities of competence through mathematical worlds. *Math. Think. Learn.* **2008**, *10*, 201239.

What is the Role of Explicit Instruction in Shifts-Aligned Math Instruction?

Shifts-aligned math learning begins with students thinking about an unfamiliar problem and the ways they might use what they already know to solve it (*Shift 1*). The teacher helps students make connections between the ideas of the class and the big ideas of mathematics, leveraging explicit instruction components such as **connecting the new content to previous learning**.

When using shared, low-floor, high-ceiling tasks teachers explicitly support students with connecting varied strategies, ideas, and representations *(Shift 2).* Additional explicit instruction components are utilized here, such as encouraging students to **verbalize the strategy** they are using to think about or solve the problem and their **reasons** for doing so.

NYCPS' high-quality math instructional materials include opportunities in each lesson for students to use discourse to develop understanding *(Shifts 3 and 5)*. As students explore core concepts, strategies, and representations, the teacher integrates explicit instruction components such as **offering specific affirmative or corrective feedback** (*Shift 4*) and **checking for student understanding**.

How does Explicit Instruction Show Up in our Shifts-Aligned Math Approach and Curriculum?

Explicit instruction is interwoven into our shifts-aligned instructional model through clear lesson goals, structured opportunities for students to practice grade-level, standards- aligned content, and strategically guided teacher supports that leverage students' understanding and promote sense-making of mathematical ideas, representations, and language. Through activities, discussions, and regular synthesis opportunities, teachers prompt and support deep thinking by strategically introducing mathematical representations, language, and strategies that are connected to students' informal, rough draft thinking.

Lesson Component	Examples of Explicit Instruction in Practice
Lesson Launch *The teacher helps students make connections between the ideas of the class and the big ideas of math.* *The teacher invites students to begin with sensemaking by effectively structuring launches, routines, and activities.*	● The teacher **clearly identifies the skills or concepts** to be learned by sharing a student-friendly lesson objective at the start of the lesson to support student focus on the intended learning goals. ● The teacher **connects** the learning goal to specific content from a previous lesson, or activity. ● The teacher **gives precise instructions** when explaining an upcoming activity/problem to ensure students understand what the task is asking of them. *One effective way to do this without showing kids what to do is to ask students what a bad, incomplete or wrong response might look like, which illustrates non-examples and doesn't remove the rigor from the activity.* ● The teacher provides **contextual information** by previewing non-mathematical academic or contextual vocabulary in the upcoming activity that are unfamiliar to students and would otherwise hinder student engagement in sensemaking.
Discourse-Driven, Structured Work Time *The teacher engages students in meaningful small group discussions during the deep study / structured work time.* *The teacher actively monitors and provides asset-based support.*	● The teacher **provides opportunities to practice new and previously learned content,** utilizing: ○ **Collective Practice** *(students work on problems together)* ○ **Teacher Feedback** *(teacher actively monitors student groups to provide feedback, taking note of representations, solutions, strategies and misconceptions)* ○ **Individual Practice** *(students work on problems independently)* and ○ **Synthesis** *(teacher uses collected notes of representations, solutions, strategies, and misconceptions to synthesize learning with students)* ● The teacher intentionally monitors students' mathematical work and discussions, encouraging students to **verbalize strategies and rationale for use**. ● The teacher uses **affirming, mathematical feedback** to build student confidence ● The teacher uses **corrective feedback** to maintain the atmosphere of productive struggle without causing frustration. The corrective feedback is grounded in student strategies and builds on their thinking while not giving away the math. ● The teacher **leverages existing student knowledge and carefully sequenced work** to **formalize student thinking** and develop **precise vocabulary and language**. ● The teacher notices when struggle in the classroom is no longer productive, and revoices 1-2 successful student approaches/strategies or engaging in a **think-aloud** to support getting students back to a place of mathematical sensemaking. ● The teacher provides **additional language support** when the language demands of the task are a barrier to accessing the content for students.
Synthesis *The teacher facilitates a meaningful synthesis of ideas during whole-class discussions*	● The teacher uses a formative assessment to **gauge student understanding** of the underlying lesson concepts prior to the exit ticket or cool-down so that extra support can be provided before the end of class. ● The teacher **emphasizes the activity/lesson's key points** to ensure mastery of the lesson objectives, including revoicing or thinking aloud for all to re-engage with prior to the end of the lesson.

Teachers begin each lesson by ensuring students understand what is being asked of them as well as ensuring they have an entry point by igniting curiosity, prompting prior knowledge, building conceptual understanding, increasing procedural skill and fluency, and engaging in tasks that allow them to practice and apply their understanding in real-world context problems using intentional instructional routines. Through independent and collaborative activities and teacher feedback, students are supported in making connections to the lesson goal, using mathematical language, and solving problems to formalize a deep understanding of algorithms, mathematical vocabulary, and abstract concepts.

Overall, shifts-aligned instruction exemplifies the research-based instructional approach of using high-quality, discussion-rich curricula infused with opportunities for explicit instruction. **Linked below are three 7th grade sample lessons from Illustrative Math, Amplify Desmos, and iReady.** Detailed in the arrows are examples of where opportunities for explicit instruction exist within shifts-aligned instruction, supported by high-quality instructional materials. Each call-out denotes explicit instruction practices, coupled with specific places within the lesson that are helpful for teachers to refer to as they plan to support all learners – especially those with diverse needs.

Illustrative Math - Explicit Instruction Guidance (Grade 7, Unit 5, Lesson 8)
Amplify Desmos - Explicit Instruction Guidance (Grade 7, Unit 5, Lesson 7)
iReady - Explicit Instruction Guidance (Grade 7, Unit 3, Lesson 11, Session 2)

Explicit Instruction Moves, Common Pitfalls and Suggestions

Explicit Instruction Move	Pitfall to Avoid	Instead, try…
Clearly identify the skills or concepts to be learned, which might include highlighting important details **Give precise instructions**	**Including so many details and instructions** that the procedure is given away before students have a chance to engage in sensemaking; providing *just in case* rather than *just in time* support.	…following the "warm-up/start/launch" instructions in the teacher guide. …internalizing the lesson to have knowledge of prior and future learning to provide just-in-time support.
Connect the new content to previous learning and **non-mathematical academic and contextual vocabulary (Tiers 1 and 2 vocabulary)** students will need in order to engage in any sensemaking activities.	**Undermining the activity by pre-teaching new mathematics vocabulary (Tier 3 vocabulary).** Activities in shifts-aligned HQIM are carefully designed to help students explore new concepts. Closing the lesson with new math vocabulary gives students a name for the new concept they explored. Starting by previewing mathematics terms can prevent the development of conceptual understanding and hide misconceptions.	…introducing non-mathematical vocabulary and reviewing mathematical language from prior lessons that students need to make sense of the activity. …allowing students to grapple with the math concept and then follow with an opportunity to authentically introduce the words for the concept they have explored during the lesson synthesis. …considering asking these questions when reviewing an activity: ● What mathematical academic language must students know? ● What language in the problem could be supported? ● What language should students use in their answers?
Provide opportunities to practice new and previously learned content, using the following sequence: 1. **Collaborative practice** 2. **Individual practice**	**Guiding students through a problem as a whole-group and skipping collaborative and/or individual practice** due to assumptions about a students' inability to productively struggle.	…following the "activity/problem" instructions in the teacher guide. …actively monitor while students are working, providing strategic pauses as needed to address trends of misconceptions, and ensuring student strategies are aligned to the lesson goal.
Offer specific affirmative or corrective feedback (i.e. math reasoning, solution strategy, language) followed by **time to revisit thinking**; includes reengaging and clarifying instructions.	**Providing corrective feedback** that doesn't uncover or address underlying misconceptions or partial understandings.	…asking probing questions to better understand student thinking, listen to their response and then, provide corrective feedback that makes use of and builds on their developing thinking.

Explicit Instruction Move	Pitfall to Avoid	Instead, try…
Leverage existing student knowledge and carefully sequenced student work (i.e. representation and solution strategies) to **formalize student thinking** and develop **precise vocabulary and language.**	**Asking students “who wants to share?”** during the activity synthesis/connect it.	…actively monitoring while students are working, following the “synthesis/connect it” instructions to strategically select students whose work will support the lesson goal: ● Ensure that key mathematical ideas are made public and remain the focus. ● Selection of student work should not be random, but must be strategic to ensure that selected student work demonstrates accomplishing the lesson goal. ● Student work is intentionally sequenced to present a coherent storyline, address/revise misconceptions, and promote equitable access to the learning.