Whitepaper

Integrating Effective Teaching Practices

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Introduction

In *Principles to Actions* (National Council of Teachers of Mathematics, 2014), eight Effective Teaching Practices are described that help teachers engage students in the habits of mind highlighted in the Mathematical Practices (Common Core State Standards, 2010). (See below.) These effective strategies often represent a shift in instructional practice for many teachers and may seem overwhelming to implement. In this paper, we will be discussing manageable ways to adapt effective teaching practices, including using routines and basic teacher moves that can be implemented immediately and refined over time.

NCTM Teaching Practices (NCTM, 2014)

Effective mathematics educators:

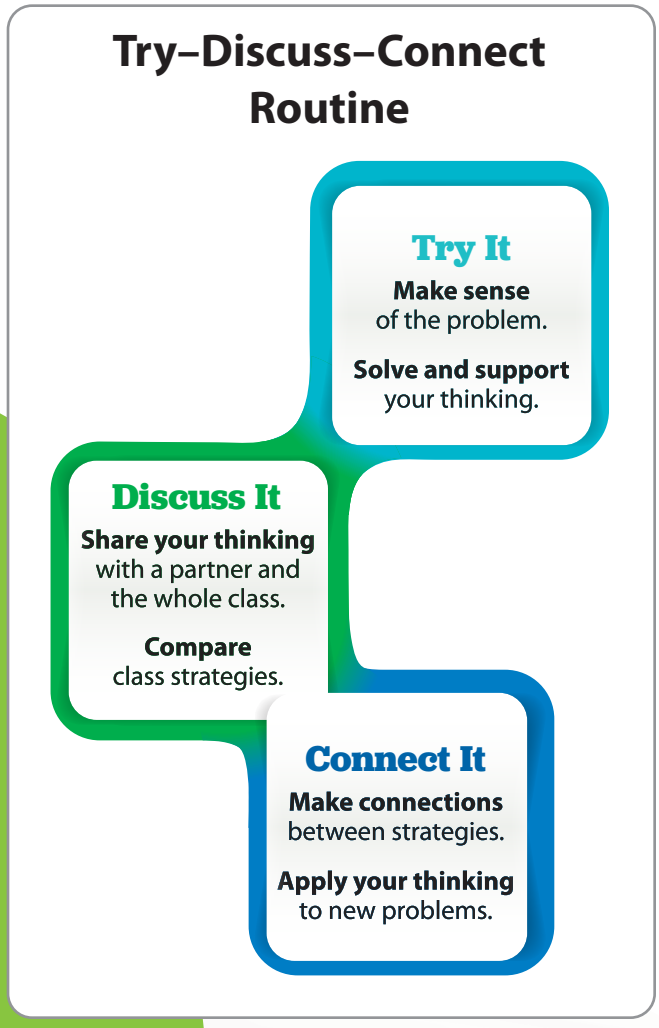
1. Establish mathematics goals to focus learning.
2. Implement tasks that promote reasoning and problem solving.
3. Use and connect mathematical representations.
4. Facilitate meaningful mathematical discourse.
5. Pose purposeful questions.
6. Build procedural fluency from conceptual understanding.
7. Support productive struggle in learning mathematics.
8. Elicit and use evidence of student thinking.

Standards for Mathematical Practice (CCSS, 2010)

Mathematically proficient students:

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

The Importance of Instructional Routines



Instructional routines are gaining greater popularity in mathematics classrooms as effective ways to support teachers in engaging students in the Mathematical Practices and increasing students' mathematical understanding. Instructional routines are designs for interaction that organize classroom activities (Lampert & Graziani, 2009). Instructional routines are meant to be repeated, and this repetition makes them very effective vehicles for developing mathematical practices (Kelemanik, Lucenta, & Janssen Creighton, 2016). Their predictable design and repeatable nature provide a number of benefits to students and teachers, including:

- Making interactions between students, between students and teacher, and between students and the mathematics purposeful, consistently executed, and easier to manage
- Freeing up students' brain space so they can focus on the mathematical tasks at hand, rather than classroom instructions and processes
- Freeing up teachers' brain space so they can focus on eliciting and using evidence of student thinking
- Supporting educators in developing their mathematical teaching practices—especially when those teaching practices are intentionally woven into the design of the routine

As teachers work to implement NCTM's Effective Teaching Practices (*Principles to Actions*, 2014), instructional routines that embed explicit high-leverage teaching moves at their heart provide regular opportunities for teachers to mindfully develop them. For example, the Try–Discuss–Connect routine found in *i-Ready Classroom Mathematics* (Curriculum Associates, 2020) promotes the facilitation of meaningful mathematical discourse as described by NCTM by including Individual Think Time, Turn and Talks, and the "Four Rs" (repeat, rephrase, reword, record) to ensure all students are reasoning and communicating mathematically.

Teacher Moves That Engage Students in Discourse and Mathematical Thinking

Mathematical discourse is a powerful sense-making tool, but it doesn't just *happen*. Students must develop both the inclination and habit of attending to each other's mathematical ideas, and they must have the time and space to make sense of, critique, and develop the ideas. Teacher talk moves are crucial supports for developing students' capacity to engage in productive mathematical discussions (Kazemi & Hintz, 2014; Chapin, O'Connor, & Anderson, 2009). Let's unpack the three talk moves in Try–Discuss–Connect that work in concert to ensure that all students are taking up and talking productively about one another's mathematical ideas.

Mathematical discourse is a powerful sense-making tool, ***but it doesn't just happen.***

Individual Think Time (ITT)—Individual Think Time provides students a short time—typically 10 seconds to 2 minutes—to think about a question or problem before discussing with a partner, a small group, or the whole class. This private processing time significantly increases both the quantity and quality of student talk because it gives students time to make sense of the question or problem and begin to gather their thoughts and questions.

Turn and Talk—A Turn and Talk gives students an opportunity to share their thinking or ideas with a partner. Teachers often use this teacher move to prepare students for a full group conversation or when students go silent during a whole class discussion (Kelemanik et al., 2016; Chapin et al., 2009; Kazemi & Hintz, 2014). It provides a safe space for students to work through ideas, questions, and language, and it ensures all students have opportunities to "talk math," not just the fraction of students who speak in a whole class conversation.

The Four Rs—The Four Rs—repeat, rephrase, reword, and record—is a strategy that strings together discrete talk moves in order to support students in processing information shared in classroom conversations and to help them develop mathematical understanding and the language to communicate it. Kelemanik, Lucenta, and Janssen Creighton (2016) call the Four Rs "an essential strategy for helping students make sense of classroom discussions."

The goal of these three teacher moves is to engage each and every student in productive mathematics discourse. As such, the focus of each is sense making rather than merely answer getting or answer telling. They provide the time, structure, and support to engage students in the co-construction of mathematical ideas and understanding.

Individual Think Time

Imagine that someone presents an image or representation to you and immediately begins asking questions about it and/or talking about its features, but you can't even hear what they are saying because you're trying to interpret and process the image or representation. If that's ever happened to you, you likely recognize the need for Individual Think Time!

Individual Think Time is a purposeful, quiet pause that allows students to interpret a question, model, task, or strategy that a teacher or classmate shares verbally or visually. Individual Think Time may sometimes be 10 seconds, or sometimes two to three minutes, depending on the complexity of the task and the thinking required to make sense of it. The purpose of ITT is to allow each and every student to enter a discussion about mathematical concepts that will be shared. It provides processing time for students to make sense of what they are looking at or what they just heard and begin to formulate their own thinking in relation to it.

Individual Think Time provides students access and readies them to begin talking with classmates. ***All* students benefit from Individual Think Time in varying ways.**

- Students may make observations, develop insight, and/or begin to think of questions they want to ask.
- English Learners (ELs) may be processing the language they see or have heard, or retrieving language in order to begin discussing with a partner.
- Some students with learning disabilities may be taking a few seconds to focus or to process the meaning of what they heard or are looking at.

When teachers begin to implement Individual Think Time, they plan for the moments that students will need to pause before responding to a question or discussing with a partner. They anticipate which representations or strategies students will share and how long it will take their classmates to make sense of them. If students are interpreting a short question or problem situation, they may only need 20–30 seconds. If they are making sense of a classmate's strategy that differs from their own, they may need a minute or so. Teachers then observe the classroom to make a decision regarding when to transition from ITT to partner discussion. The goal is for all students to be able to think about the problem without frustration and begin at least a partial solution strategy before entering into a partner conversation.

It is important that students do not raise their hands to respond during Individual Think Time. You may want to use hand signals close to students' chests to signify when they have an idea to share, a response, or are ready to begin working with a partner. Encourage students who have a response early to think of another approach, if applicable.

ITT Prompts

When launching ITT, teachers make expectations for this time explicit to students, with prompts such as:

"OK, class, take 20–30 seconds to make sense of this number line on your own."

"I'd like you to take about 30 seconds to think on your own about this question."

"We'll start with private think time." or "Take a moment to think by yourself."

"When I project the model from our text, I'd like you to take a minute or two to make sense of it individually."

Getting Started with Individual Think Time

- **Consider when students will need to make sense** of questions, representations, strategies, or worked examples during a lesson, and how much time students will require to process the information on their own.
- **Craft a prompt for ITT that will remain consistent** *(Example: "Take a moment to think by yourself" or "We'll start with private think time.")*
- **Design a reminder for yourself to prompt the ITT.** For example, build an icon into your slide deck, or put a sticky by the document camera that you use to project student work.
- **Pay attention to the timing of ITT.** Consider, what happens when you cut think time too short? What is the effect when you provide longer ITT? Adjust accordingly.
- **Share with students that taking time to think and process information is a practice that many people use, especially mathematicians.** You may want to share an example from your life, such as how you and the other teachers take time to process ideas before you discuss them in staff meetings.

Common Pitfalls When Teachers Implement Individual Think Time

- **Launching ITT but then continuing to give directions or clarifications.** This distracts students and interrupts their quiet think time.
- **Allowing students to talk during ITT.** This robs students of quiet sense-making time. Remind students they will have time to talk with their partner soon.
- **Providing *too much* time for ITT.** This results in students diving too far into their own work and may cause them to want to continue working individually even when they are expected to transition to working with a partner.
- **Providing a rigid timeline for ITT by setting a timer.** Teachers should monitor student thinking to determine if they have not yet had enough time or if they've had too much time, rather than let ITT be controlled by a timer instead of teacher discretion.
- **Allowing students to raise their hands as soon as they have a response or idea.** Other students may get anxious that they are not thinking quickly enough and give up. Instead, have students use hand signals close to their chest or have students wait until you ask students to respond to the question.
- **Supporting students with their thinking.** This is not the time to differentiate instruction or step in to provide personalized attention. Allow students time to think and persevere.

Turn and Talk

Have you ever posed a purposeful and well-designed question to a class, provided individual think time, and then struggled to draw responses from students in the full group? When students try to share their thinking with the whole class "cold"—without the benefit of "warming up" by turning and talking to a partner—they often stumble over their words, try to develop their thoughts as they are speaking, or stop themselves short because their thinking is not developed enough to continue sharing with confidence. A carefully placed Turn and Talk—a teaching move that prompts students to discuss an idea with a partner—helps students and teachers avoid such obstacles. **Turn and Talks provide an important middle step: the opportunity for students to work out their thinking and the language they will use to support their thinking with a partner.** During the Turn and Talk, teachers are able to monitor the thinking that students are developing and note ideas they may want to have shared during the whole class discussion.

Turn and Talks allow a variety of learners additional time and another modality to develop a more coherent and articulate thought. The advantages of using Turn and Talk include:

- Allowing all students to talk through ideas with a partner engages each and every learner in the classroom, gives every student an opportunity to speak and be heard, and allows all students to develop a rough draft of their ideas should they be asked to share their thinking in the full group.
- ELs talk with a partner, often pointing and gesturing to support their language, and have the added benefit of listening to their partner to support their own language development.
- Some students with learning disabilities benefit greatly from a Turn and Talk as it allows them to process an idea verbally, or simply take additional time and use repetition to refine an idea.

Turn and Talks provide critical supports for all students, albeit for different reasons, to practice mathematical language, process ideas, and refine understanding.

In addition, teachers reap enormous benefits from listening to student conversations during Turn and Talks. As teachers circulate and hear students talk, they gain important formative assessment information from partnerships, students' ability to attend to precision in terms of language and mathematics, and are better poised to make a purposeful decision about the direction of the full group discussion. Without the Turn and Talk, teachers might hear only from one or two students.

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Prompting Turn and Talks

Although Turn and Talks are valuable tools for students and teachers alike, teachers need to implement them with purpose. If teachers ask students to talk about something with a partner, students must feel a genuine need to talk through the idea. That is, students need something to talk *about*. Harold Asturias, director of the Center for Mathematical Excellence at Lawrence Hall of Science, UC Berkeley, suggests that teachers should provide a purpose, a prompt, and a product when launching a Turn and Talk. A teacher may position students to turn and talk by saying, "Will Olivia's strategy always work? Turn and talk to your partner so that, together, you can decide if you think it will always work and justify your decision."

- **The purpose** is to work together to make a decision and justify it.
- **The prompt** is, "Will Olivia's strategy always work?"
- **The product** is the decision and justification.

In contrast, the teacher could have said, "Turn and talk to your partner about what you heard," which could result in students not having a clear idea about what they should talk about. A Turn and Talk that contains a *purpose*, a *prompt*, and a *product* always generates more thinking and language development.

*A Turn and Talk that contains a **purpose**, a **prompt**, and a **product** always generates more thinking and language development.*

Steps of a Turn and Talk

1. Pose (and possibly record or project) a clear question or prompt.

2. Provide a sentence frame or starter to prompt partner talk.

3. Provide a time estimate (that you may adjust as you listen to students).

4. Listen to students as they discuss, select, and sequence responses.

5. Reconvene the class and remind them of the prompt.

6. Purposefully call on students to share their thinking and transition back to a full group discussion.

When to Have Students Turn and Talk

There are a few key indicators of when teachers should use a Turn and Talk:

- **When nearly every student is eagerly raising their hand to offer an idea**
  When lots of students want to share their thinking, Turn and Talks provide all of them the opportunity to do so, rather than just one or two.
- **When no students are offering their ideas**
  When nobody is willing to speak in the full group, it often indicates that the idea needs to marinate longer before students are ready to develop the idea in the full group. A Turn and Talk allows students to process and work through the idea so a full group conversation is fruitful.
- **When the class is discussing a key component of the lesson, Turn and Talks are a good move to use to make sure students process an important idea.**
  When a student is explaining their thinking, it is sometimes helpful to have students stop to process what the student said with a partner, particularly if it is something new or critical to the class being able to understand the presenter's thinking.
- **When the teacher needs time to think about the next teaching move**
  Sometimes we, as teachers who make myriad decisions in a nanosecond, need time to think about the next teaching move that will progress students' understanding forward most effectively. So, we prompt students to turn and talk in order to buy ourselves a few seconds to transition our thinking and/or prepare materials.

*When the mathematical discussions start to simmer down, that is the time to **transition students away from their partner** conversations and back to the full group or next set of directions.*

One challenging aspect of Turn and Talks involves timing. Once teachers launch students into a Turn and Talk, teachers want to provide enough time for each student to have an opportunity to speak as well as time for the teacher to listen to as many partnerships as possible. When the mathematical discussions start to simmer down, that is the time to *transition students away from their partner conversations* and back to the full group or next set of directions. Unfortunately, teachers often find the sweet spot of timing the hard way—by providing too much time and then having to stop conversations about lunch, the weekend, and other non-math–focused topics.

Getting Started with Turn and Talks

- **Anticipate key ideas while planning a lesson** and develop a Turn and Talk around these key ideas. *(Example: For a lesson on adding two-digit numbers with regrouping, Turn and Talks might focus on the why, when, and how of regrouping.)*
- **Assign which partner will begin talking.** *(Example: If you are sitting closer to the window, you will share first.)*
- **Provide students a time frame for the Turn and Talk.** *(Example: Turn and talk to your partner—you'll have 45 seconds.)* While you may adjust the timing in the moment, the short time frame provides some urgency for students to get started.
- **Provide sentence frames for students to use when they turn and talk.** This will support students' language development and serve as a product for the Turn and Talk. *(Example: Partner 1, start with "I knew . . . so I . . ." Partner 2, respond by starting with "I agree/ disagree with you because . . .")*

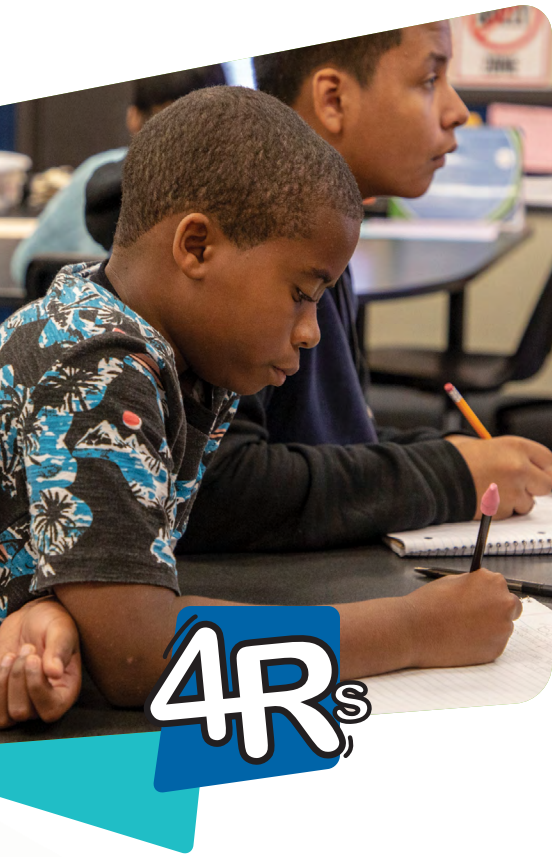
DISCUSS IT

Ask your partner: Why did you choose that strategy?

Tell your partner: I knew . . . so I . . .

Common Pitfalls When Teachers Implement Turn and Talks

- **Having students turn and talk about too simple an idea or response.** Be sure to give students something to talk *about* and avoid asking students to talk about questions or problems that are too basic. *(Example: Rather than asking students to talk about the sum of 7 and 8 with a partner, ask them to discuss how they can use their doubles facts to find 7 + 8.)*
- **Stepping in to correct student thinking or provide personalized support.** This is time for students to feel comfortable sharing their ideas with their peer(s) and having partners discuss if they agree or politely disagree with the thinking and why.
- **Giving students too much time to talk.** If the noise in the room increases in volume after a while, it is a sure sign students have quit talking about the mathematics and moved on to other conversations.



The Four Rs: Repeat, Rephrase, Reword, and Record

Have you ever struggled to follow or stay focused in a full group discussion? Or stopped to think about what was being said only to find the group had moved on and you now had no idea what they were talking about? Whole class discussions position students to co-construct knowledge and provide opportunities for students to engage in sustained reasoning (NCTM; Chapin et al., 2009). However, students often find full group discussions challenging to follow and hard to sustain, and all too often miss important points or worse yet, check out of the conversation. The Four Rs—repeating, rephrasing, rewording, and recording—help keep students in the conversation and the discourse productive. Productive math discussions start with *ensuring that all students hear the ideas being shared, have the time to process them, and then are able to communicate those ideas with increasing mathematical precision and language.* Teachers can use the Four Rs strategy to ensure all their students have access to the mathematical ideas and language shared during full group math discussions.

The Four Rs strategy is made up of four distinct talk moves:

- **Repeat**
  A student restates the idea shared if not everyone has heard it.
- **Rephrase**
  A student restates a classmate's idea in their own words—often adding onto the initial idea—in order to deepen their and the class's understanding of the idea.
- **Reword**
  Students restate the idea at hand using mathematical language to increase both the precision of the idea and the language with which it is being conveyed.
- **Record**
  The teacher publicly records the idea and/or specific language for students to reference.

Taken together, the above four moves help students refine ideas and language during full group conversations. Consider the following excerpt from a Grade 1 classroom.

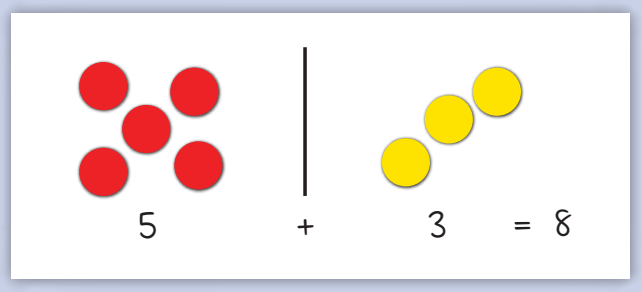
Productive math discussions start with ***ensuring that all students hear the ideas being shared, have the time to process them, and then are able to communicate those ideas*** *with increasing mathematical precision and language.*

The Four Rs in the Classroom

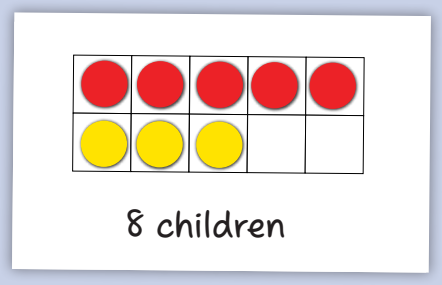
Consider the following excerpt from a Grade 1 classroom that we'll use to show an example of the Four Rs in the classroom:

A swim team has 5 girls and 3 boys. How many children are on the team in all?

Student A: Antonio



Student B: Maya



Students are considering the two student-developed strategies shown above during the whole class discussion. The classroom dialogue may sound like this:

Ryan: *"Those two are the same because they both have 5 and 3."*

Teacher: *"Who can **rephrase** Ryan's idea?"*

McKenna: *"They both start with 5, but in a different shape. And then they both put 3 more."*

Teacher records "5 + 3 = 8" and asks:
*"Who can **reword** the idea with language we've been using?"*

Katie: *"They both started with 5 and counted on 3 more to get 8 total."*

The Four Rs provide teachers a framework of questions to think about while facilitating meaningful math discussions in their classroom.

When Do You Use the Four Rs?

The Four Rs provide teachers a framework of questions to think about while facilitating meaningful math discussions in their classroom (Kelemanik et al., 2016). Which of the Four Rs a teacher uses depends on the classroom situation.

Classroom Situation	Four Rs Response
If it is possible not everyone was able to hear a response . . .	. . . then the teacher has one or two students ***repeat*** what was said.
If everyone has clearly heard what was said, **and** the idea is a key part of the lesson, **or** the teacher wants to check to see if students understand what was said . . .	. . . then the teacher has a few students ***rephrase*** the idea using different words.
If everyone understands what was said, **and** there is specific mathematical language students can use to express this idea more precisely . . .	. . . then the teacher prompts a few students to ***reword*** the idea using more precise mathematical language.
If there are important ideas, words, or images being shared that students would benefit from seeing visually . . .	. . . then the teacher should ***record*** these ideas for the class to help students process or remember key concepts and allow them to be able to better participate in the conversation.

It is worth noting that with the exception of *record*, it is the students, not the teacher, who are taking the action. That is, the students are the ones repeating, rephrasing, and rewording. This is essential for two key reasons:

1. It requires the students to do the thinking and processing (and thus the learning).
2. It encourages students to listen to one another's explanations carefully and for understanding, increasing student discourse and the role of teacher as facilitator.

Support for All Students Using the Four Rs

The Four Rs strategy *supports student processing of important math ideas* during full group discussions. It also provides a structure in which students can use and develop mathematical language. **While helpful for all students, the Four Rs strategy is a critical support for ELs and students with learning disabilities.**

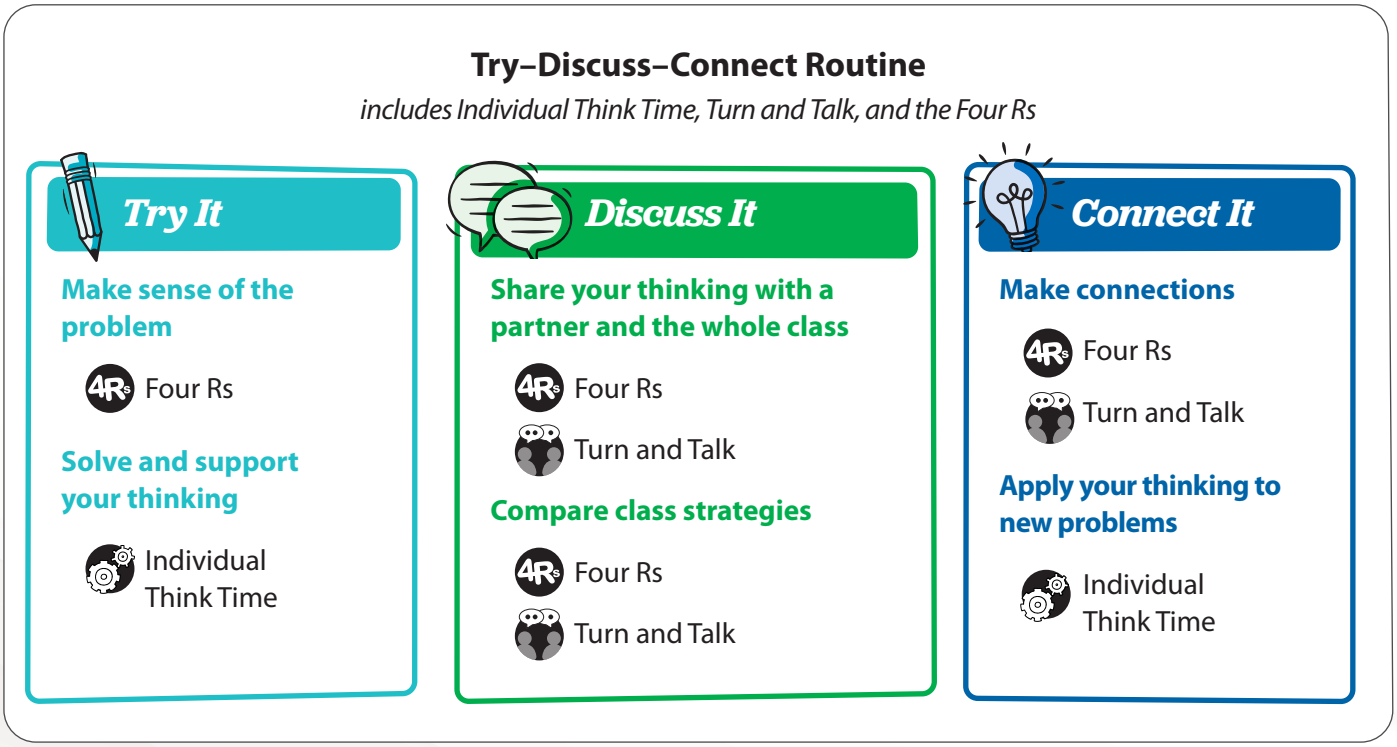
ELs are doubly challenged during full group conversations as they are not only working to make sense of the mathematical ideas being discussed, but they are also doing so in a language in which they are not yet fluent. **A full group discussion in which student ideas are repeated, rephrased, reworded, and recorded provides students, particularly ELs, much needed multiple passes at hearing the mathematical ideas being shared** and the language being used. In addition, the repeating, rephrasing, and rewording provide opportunities for ELs to use multiple modalities for making sense of the mathematical ideas while they practice producing language.

Like ELs, students with learning disabilities benefit from the multiple passes and modalities inherent in the Four Rs, but sometimes for different reasons. **Repeating and rephrasing is a support for students who benefit from verbal processing, as it provides them multiple opportunities to make sense of an idea while talking it through with others.** It also plays to the strength of students with learning disabilities who are strong verbal processors by positioning them to leverage their learning strength to make sense of and communicate important math ideas. **The repetitive nature of the Four Rs also provides ongoing support for students who struggle with short-term or working memory.** When ideas are revoiced multiple times, these students have more than one chance to intake and process the idea. When important ideas are recorded, students have visual residue to support their ability to process and recall. Additionally, the visual residue serves to engage another modality, thereby supporting students who struggle to maintain attention or focus.

The Four Rs strategy ***supports student processing of important math ideas*** *during full group discussions.*

Summary

Using the Effective Teaching Practices (NCTM, 2014) to engage students in the Mathematical Practices, particularly classroom discourse, takes time to develop for students and teachers alike. Discourse-based instructional routines that engage students in the Mathematical Practices, such as *Try–Discuss–Connect,* provide a vehicle for teachers to develop pedagogies that are repeatable every time they enact *Try–Discuss–Connect*. Without an instructional routine, teachers are left to design interactions for discourse within lessons that may vary greatly in their flow, making it difficult for teachers to use strategies consistently to enhance student learning. Similarly, students learn what to expect in math discussions when their interactions are routinized. When teachers implement Individual Think Time, Turn and Talks, and the Four Rs regularly within the routine, all students participate, at least cognitively, in the classroom conversation. As a result, students do the thinking and talking in the classroom, look to their peers (and themselves!) to construct mathematical understanding, and become empowered mathematicians.



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