Contents

CHAPTER TWO

Every Learner Can Become Numerate: The Surprising Evidence for Math Positive Teaching Techniques

The evidence for using math-positive teaching techniques for increased learning outcomes is powerful, but often significantly underestimated. In this chapter, we specifically explore how education practitioners can take steps in the classroom to successfully implement the first of the (2+6) Guiding Principles, **Create inclusive classroom environments that foster math positivity, perseverance, and risk-taking.** These teaching techniques are most effective when used with well-sequenced mathematics curricula and teaching and learning materials.

Ministries of education and the international community are moving towards higher quality education, producing significant evidence and guidance about effective teaching techniques. To support education technicians designing and implementing programs for teachers who may be coping with large class sizes and limited resources, while also aiming to be more inclusive, Chapter Two explores:

- Committing to the ongoing process of creating greater equity in the math classroom through evidence-based teaching techniques that respond to all learners' needs
- Using inclusive and culturally appropriate teaching techniques to reduce math anxiety and increase learner participation, deeper engagement, and time-on-task
- Understanding that effective teaching techniques ("the how") and numeracy teaching and learning materials packages ("the what") can be more inclusive and produce better outcomes when systematically designed to be student-centered, joyful, explicit and implicit
- Integrating everyday strategies to support teachers as they slowly integrate and practice "the how" and "the what" of teaching together in bite-sized chunks
- Considering how numeracy is a tool for social justice, and that anti-stereotypical approaches to teacher professional development and mathematics instruction empowers both teachers and learners, and helps them create positive numeracy identities.

Practitioner's Note: This Chapter is Important for Math Class, and Other Classes Too
This chapter presents general teaching and learning practices that enable the learning environment for all learners' numeracy skills and math content knowledge to develop. It is fair to say, while research shows these practices support improved learning outcomes in math class, the same practices can improve learning outcomes in literacy, and other content areas as well. Some examples from teachers in the following chapter originated in language class or at remedial reading camp; however, teachers cited transferring those techniques to other content areas they teach, including numeracy skills and mathematics content in math classes.

Creating a Math-Positive Learning Environment

The first step to numeracy is creating a math-positive environment based on the belief that math is for everyone. Evidence in mathematics education suggests that conditions such as stereotype threat and math anxiety limit performance for learners who would otherwise become good mathematicians (see text box). Cultivating confidence and trust between teachers and learners serves as a foundation for building numeracy life skills, such as perseverance and problem-solving resilience.

Techniques presented in this chapter align with Principle 1: **Create inclusive classroom environments that foster math-positivity, perseverance, and risk-taking**. It is important to emphasize that for teaching techniques to be effective, teaching and learning materials must be systematically designed using the following considerations:

- All children learn when they practice, and the best type of practice is often play-based
- Explicit instruction is inclusive by design, so that new content is taught in systematic, structured ways but quickly moves to multiple models
- A teacher can respond to a learner's needs by making connections to mathematical relationships explicit.

Girls perform better in explicit math-positive environment

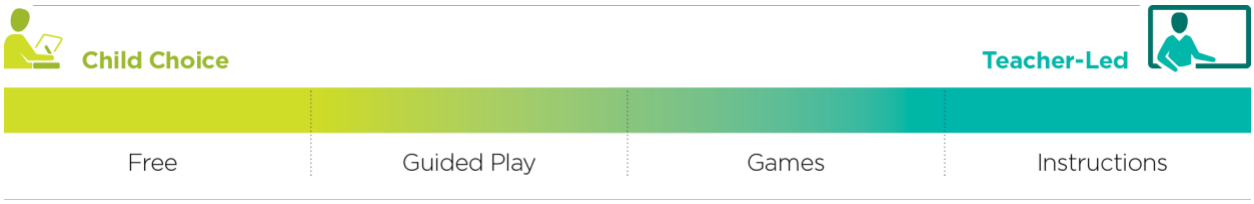
1. Stereotype threat. Social forces, such as stereotype threat, can cause girls to underperform boys in math or African Americans to underperform white Americans in cognitive tests. These achievement gaps can be reversed when simple strategies are taken to eliminate the threat – like using teacher talk when giving test directions, such as saying, "This is a test that girls and boys will show what they know and do well on." – that both populations tend to do equally well on a test (Steele and Aronson, 1995; Flore, Mulder, and Wicherts, 2018).

2. Math anxiety and mindset. Math anxiety can lead to a decrease in working memory and poorer performance. Timed tests can increase math anxiety. Girls taught by a female teacher with high math anxiety are more likely to perpetuate gender-related stereotypes about math ability. (Boaler, 2013)

3. Collaborative learning. Girls do better in math when collaborative activities and a positive growth mindset are present. (Dweck, 2006)

When teachers facilitate any learning activities on the spectrum (see Diagram 1 below), they increase engagement, action, and expression (See Diagram 3). Using effective techniques in conjunction with systematically structured learning activities can create a more math-positive classroom, with the ultimate aim of building positive mathematics identities for all learners.

Diagram 1. Learning Activities Occurring in Structured Pedagogy Programs for Numeracy

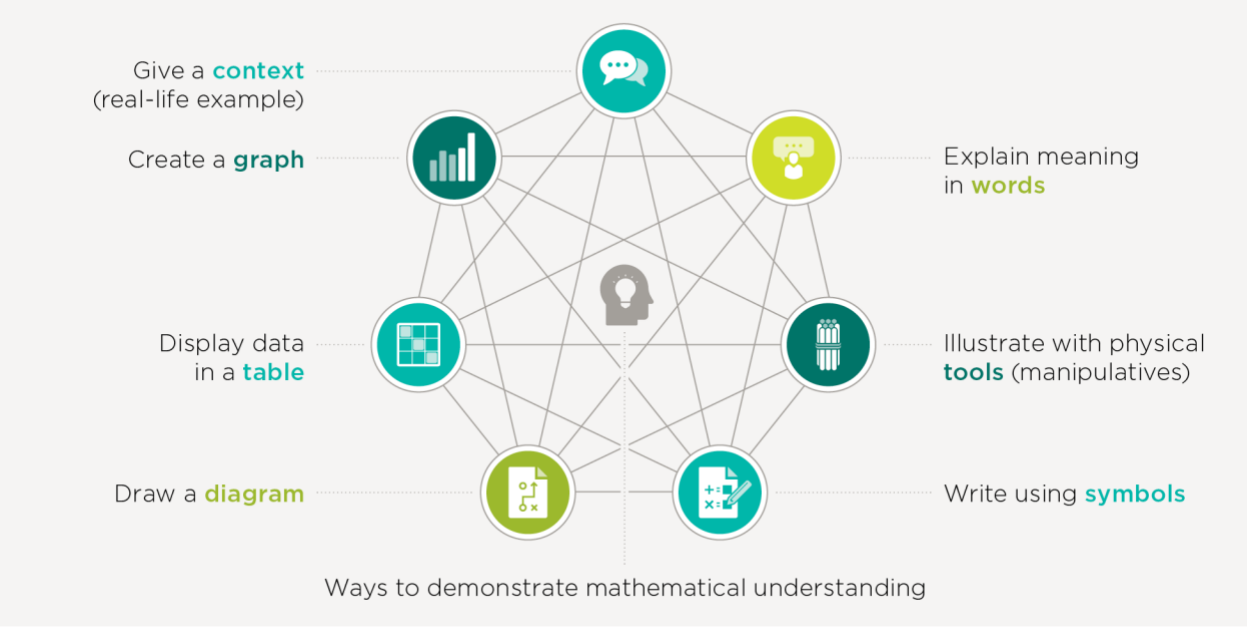


Importantly, math-positive learning environments are not just for statistically underperforming groups. All students benefit from systematic and explicit instruction that is delivered with culturally appropriate teaching techniques applied responsively by a classroom teacher. This whole class foundation, sometimes referred to as the first tier of intervention, is ideally designed to deliver a treatment and dosage that is contextualized so that all learners can participate, grow, and benefit (Sprick, Booher, and Garrison, 2009). Some learners need the first tier of treatment *and* a second targeted intervention to demonstrate growth. Additionally, a smaller number of learners will need an additional third layer of individualized support.

Diagram 2. Multi-tiered Systems of Support

Additionally, all learners will benefit from effective teaching techniques used responsively by their teachers, integrated into the planned system of instructional activities within each tier of support in a numeracy program. At each tier of support, learners need multiple representations (See Diagram 2) and time for practice at independent and instructional levels, paired with effective techniques that increase engagement, action, and expression in order to grow towards mastery of numeracy competencies.

Diagram 3. Multiple Representations Web



The Impact of Effective Teaching Techniques on Numeracy Learning Outcomes

Effective teaching techniques are the small, simple ways teachers can increase gender equity, support language learners, further apply Universal Design for Learning (UDL) principles, and provide psychosocial support in the mathematics classroom (CAST, 2018). While some learners will need additional supports, all learners need teachers who are equipped with quality instructional materials and effective teaching techniques (See ***Instructional Models for Making Mathematics Meaningful***). Curricula for numeracy and mathematics programs must provide teachers with simple tools and support for facilitating learning through multiple representations (See Diagram 3), which are delivered

systematically and explicitly. However, if teachers are increasingly encouraged to concentrate on the scripted instruction, education technicians run the risk of underestimating the value of the responsive things that teachers do to make learning engaging and the impact it can have.

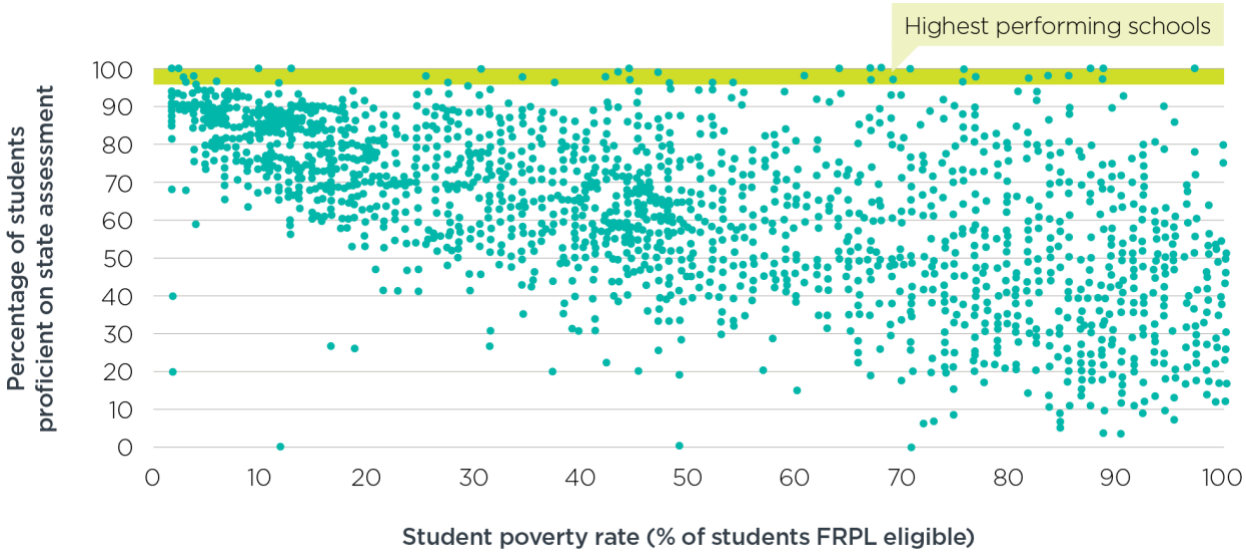
Here is a recent example from USAID Tajikistan Learn Together Activity, (LTA). Takhminakhon Huseynova, a high-performing teacher and current LTA Numeracy Materials Specialist, who participated in the predecessor program, USAID Read With Me (RWM) training as a teacher, stated that:

> "RWM training was [a] great inspiration for me as primary teacher. I was very eager to try out the proposed techniques in my Tajik language classes initially, and slowly began trying the ideas in math lessons as well. For example, the "ball paper" technique worked very well in my language lesson. I observed students' motivation for learning increase and asked myself can I adapt and extend it? I decided to use it in math lessons. I used the ball in skip counting exercises in my grade one lessons and found it very engaging for students. They were more eager to participate when math fact practice felt like a game. I was motivated to use it in my lessons for different topics and suggested it to my fellow teachers as well. Similarly, I started applying Venn Diagram, Frayer model, and other strategies in teaching mathematics to my students."

To understand how certain teachers get such high learning outcomes, world renowned international teacher/researcher Doug Lemov looked at math scores from the highest performing classrooms across all socioeconomic levels in his home state of New York (See Diagram 4). He then set out to study the teachers behind those learners and what happened in their classrooms.

The results showed that despite vast differences in the backgrounds and socioeconomic levels of the learners, the teachers of the highest performing learners had specific behaviors — "the little things" — in common. He was then able to identify and codify these commonalities into a taxonomy of effective teaching techniques. (Lemov, 2015).

Diagram 4. 2011 Sixth Grade Math Results – All New York State School Systems



The taxonomy of effective teaching techniques continues to grow and gain validation as more teachers and instructional leaders are studied around the world, and as more schools and organizations start

identifying and practicing techniques at various degrees of scale across low, middle, and high-income countries (i.e., Cameroon, Chile, Guatemala, Israel, Liberia, Malawi, Mexico, Rwanda, South Africa, Tajikistan, Uganda, and Uruguay.). The taxonomy has also been revisited in light of the shift to distance learning modalities and revised to reflect effective teaching techniques in synchronous and asynchronous virtual delivery (Lemov, 2020). In each new location, be it brick and mortar or virtual, research showed the importance of validating the cultural appropriateness of teaching techniques and customizing techniques according to local context. Similarly, the introduction of a taxonomy of specific effective teaching techniques was consistently associated with better learner performance, further discussed in the examples below.

Practitioner's Note: Discover and Rediscover, Don't Import!

Many effective teaching techniques are universal, but the process of studying effective teachers in local contexts, identifying common techniques, and codifying and determining how to appropriately disseminate techniques builds trust, authenticity, and the capacity for more growth. Discovering and rediscovering these techniques as part of a system for continuous professional improvement must be the focus for decision-makers at all levels. If decision-makers fail to invest in and emphasize the process as best fits their unique contexts, there is a risk of importing a methodology which could lead to applications guided by dogma rather than context.

For teachers, empowerment often comes down to owning "how" to teach "what" the teachers' guide, textbooks, and supplemental materials for math class provide. Effective teaching techniques, sometimes referred to as "teacher craft" or "teacher moves," are not written into lesson plans or teachers' guides, but can be identified, codified, and introduced through practical exercises. These exercises can be practiced in a variety of low to high-tech training scenarios with support from coaches, peers, and communities of learning. As a teacher's awareness and intention about using the successful techniques to build numeracy in the classroom grows, so does equity and engagement for all learners. The teaching burden lessens as teachers see that owning "how" they teach with the materials they are given (the "what") can lead to increased participation from learners, especially those with visible — or invisible — disabilities.

With these techniques at work in the classroom, even if a learner cannot yet answer a question, they will feel empowered to "stick with it" because they know their teacher will use techniques and tools to support them when exploring the problem. Confidence grows as children become *expert learners* (CAST, 2017), secure in learning how to learn, and knowing that learning means sometimes you must get it wrong before you get it right. Classroom culture grows when a teacher has the competence and confidence to apply these techniques responsively to learners' needs, which are ideally integrated into activities on the spectrum of learning that range from teacher-led to learner choice for more practice (See Diagram 3 and ***Instructional Models for Making Mathematics Meaningful***). Comprehensive numeracy programs that integrate such teaching techniques are more inclusive and empower learners and teachers to work together towards a growth mindset where trial and error is standard practice.

Empowering teachers through exploring the impact of teaching techniques

To integrate effective teaching techniques with a prepared teaching and learning materials (TLMs) package, education technicians must undertake a systematic process to pinpoint desired results, study teachers who deliver those results, identify common behaviors, and codify a "shared vocabulary." Buy-in

and replication happen when teachers see a proof of concept that allows them to recognize a technique they were already doing, or see someone like them doing it in a situation like theirs, thus giving them confidence they can also incorporate these practices in their teaching. Real uptake happens when teachers increase their intentional use of one or two techniques at a time, bolstered by supports, such as coaching or communities of learning, focused on helping them practice those small changes, which can lead to big results over time.

Continuous professional development that supports teachers to initiate ***micro-changes*** and ***micro-innovations,*** such as Takhminakhon's paper ball, also provides teachers with local examples and proof of concept that techniques work in an environment that looks like their own.

Practitioner's Note: Use Focus Themes to "Shrink the Change"
Instructional leaders and coaches need to make careful decisions about how and when to introduce specific techniques into continuous professional development activities in digestible amounts where teachers can practice meaningfully in their own classrooms. Coaches and educational leaders need to be responsive to the teachers they support, just as teachers need to be responsive to the learners they teach. Teachers need low stakes opportunities to practice using the right technique at the right time according to the moment of instruction between teacher and learners.

In Tajikistan, the team at USAID Read With Me and Learn Together Activity carefully designed and implemented a blended learning approach disseminated in "bite-sized" bundles of two to three focus themes. Aligned with the national teacher competency framework, the blended learning approach applied UDL principles for teachers through a comprehensive package for teacher support in literacy and numeracy continuous professional development. This package — practice-based modules for teacher self-study and communities of learning, a suite of culturally appropriate effective teaching techniques, 96 concise videos of several techniques in various Tajik classroom contexts, face-to-face and tele-coaching, supplemental materials — and all converge in a digital platform that functions both off and online. The digital platform serves as the "convener" consolidating data from 223 coaches and 30,000 teachers at 6,000 schools, working to drive reform at the classroom and system level.

Practical Techniques for a Math-Positive Environment

Effective Teachers Create a Culture of Error

Good teachers of numeracy skills and math content are constantly perceiving learner feedback from each learner interaction. Teachers get feedback when they scan learners working together during a group activity, listen to what they whisper to each other in a "Think-Pair-Share" exercise, look at student work in exercise books from an activity such as "Roll and Write", and find that more than half the class does not have answers for facts in families higher than 3 or see that a learner keeps getting the same step incorrect when doing exercises during independent practice. These moments are challenging because the teacher must make a real-time decision about how to respond, which may not follow in their teachers' guide or lesson plan. This is particularly risky when the teacher is being monitored or supervised by an authority who may be functioning under the misconception that teachers must stick to a lesson plan word for word.

According to Lemov, teachers make it safe for learners to struggle by respecting error, withholding the answer, managing how much the teacher tells, and praising learners who take risks (Lemov, 2015). Van de Walle (2018) describes this as teachers who orchestrate classroom discourse that leverages mistakes and misconceptions, which is possible when learners are expected to practice active listening and trained to expect accountable and productive talk to solve problems together. Put simply, teachers who take

responsive actions are creating a culture of error such that mistakes are seen not as failures but ways of learning. Some examples can be found in Table 1.

Table 1: Sample Classroom Discourse That Normalizes Error

Observable Feedback or Learner Data	Teacher Response and Learner Interaction	Learner's Response
Sees learner tasked with recognizing and repeating an A-A-B pattern with bottle tops. The learner is randomly lining up bottle tops of many colors after the given red, red, or orange model.	**Ts:** Miguel, I see that you are working with more colors than two colors. What is the pattern you were given to repeat? **Ls:** A, A, B **Ts:** How many colors will you need to show that pattern? **Ls:** Two, I can pick out two colors, all the reds and oranges. **Ts:** Great, then what? **Ls:** I can put a red for A, next a red for A again, then an orange for B. **Ts:** Now how can you show a pattern? **Ls:** I make another red, red, orange. **Ts:** Yes, and how will we know that red, red, orange is the pattern? **Ls:** I can move this red next to the last orange, then another red and an orange. Then I can do it again. **Ts:** Now you can do it on your own and help others. Marcos has another pattern for A-B-C. Can you partner with him to repeat a new pattern? See how many times you can repeat it. Remember to take turns placing each of the bottle tops. **Ls:** Yes, I can help Marcos.	Thinks about the task he is attempting. Confirms he understands the task. Identifies a logical next step to completing the task. Finds a way of representing the pattern. Transfers the single instance of the pattern into a linear series of repeating instances. Capable of independently using strategies to recognize and repeat new patterns. Affirms positive mathematics identity as a helper and a partner.

Effective Teachers Know Joy is How the Hard Work of Learning Gets Done

Studies show learning mathematics through games and play provides better learning outcomes than more traditional methods (Castellar et al., 2014; Jabbar and Felici, 2015). Takhminakhon's earlier example of the "paper ball" technique is simple, but rich with facets of joy that make the hard work of learning more agreeable. By adding a simple tool, i.e., a ball made from scrap paper, to a skip counting exercise, Takhminakon introduced a bit of suspense and challenge into a routine activity that often defaults to rote memorization. It is easy to imagine, even in her large classroom, that learners are on the edge of their seats wondering when the ball will get tossed to them and tracking the multiples of five on the 100s chart to make sure they are ready to answer if the ball comes their way. This example also demonstrates how games can be integrated to make a teacher-led moment of instruction more student-centered.

> Interventions that involve free and guided play are more likely to demonstrate all characteristics of learning through play and are more likely to close achievement gaps. This suggests a strong link, across very different settings, between children's choice, enjoyment, iteration, and learning.
>
> *(Lego Foundation, 2018)*

Effective teachers create a sense of belonging and integrate a team spirit in the classroom so that all learners know they are working together. This can take the form of special names or titles, or various "team spirit" rituals and routines unique to their classroom that make each learner an "insider" in ways that affirm their value and belonging as part of the community of learners. Some examples of how teachers infuse can infuse joy across the spectrum of learning activities they facilitate by adding fun and games through challenge and competition are:

- Collaborative relay races to get through math facts practice
- Setting a timer on a cell phone to see if the whole class can get more math facts correct collectively today than they did the day before, or meet a goal by the end of the week
- Seeing which group can use the most interesting models (bottle tops, sticks, leaves, etc.) to demonstrate a mathematical expression
- Giving "points" (e.g., checks on the chalkboard or stones in a bottle) to reinforce desired numeracy behaviors, such as answering in complete sentences or including units when answering.

Effective Teachers Give Positive and Precise Feedback

It is important to note that acknowledgment is language that affirms learners are doing what is expected, and cues other learners listening that they should do it, too. The language teachers use for praise makes it clear exactly how a learner or learners have gone above what is expected and communicates to other learners that type of behavior is encouraged (Lemov, 2015).

> "Training on and practicing techniques at the Kinyarwanda Reading Camp improved my ability to provide precise praise and recognize positive behavior. Now, in all my lessons at school, if learners are doing well, I say specific things like 'thank you for following the lesson' or 'thank you for covering your textbook nicely to protect it.'"
>
> *–Nzabambizi Slyivie, a P1 Teacher at GS Rugali in Burera District, Rwanda*

Teachers should use language that is precise and descriptive of the specific desired behaviors or actions in the learning environment. Saying "good boy" or "good girl" doesn't help a learner understand why they are earning praise or

acknowledgment or give other learners clues about what to do so that they can also earn that kind of praise.

Here are some examples of sentences that show acknowledgment or precise praise:

- “Thacien, I am calling on because you raised your hand and did not shout out an answer.” (acknowledgment)
- “This row is showing me they have listened to directions. They all have their exercise books and pencils ready to begin copying the number line and circling the numbers we say when we skip count by twos.” (acknowledgment)
- “Proto, thank you sharing your counting sticks with Sharon. You saw that your friend needed sticks and assisted her. These learners are showing us how friends work together so that everyone can participate. (praise)
- “Dative, you are using the bottle tops to find an answer. Good mathematicians use tools to help them solve problems.” (acknowledgment)
- “Table three is sitting up, nodding their heads and looking at the speaker. They are listening to what Martin says about his solution. They will probably be the first classmates ready to ask Martin questions about how he got his solution.” (acknowledgment and praise)

In a community of learning meeting at school, teachers can do a training exercise where they 1) sort sentences into categories of acknowledgement or praise, 2) reflect on a moment from the week where acknowledgment or praise might have made for a more positive learning environment in their classroom, and 3) pair up to write down and practice by acting out what they would say and do next time there is an opportunity to give acknowledgement or precise praise in their classroom.

Effective Teachers Use Wait Time: Wait Time is Think Time

When asked a question, learners need at least five to ten seconds to think before the teacher calls on them. The longer a teacher waits between asking a question and getting an answer, the more learners will raise their hand and participate. If a teacher only waits one to five seconds, the same learners who are fast — though not always correct — are the ones who always get to participate.

Teachers should give at least five to 10 seconds of wait time before calling on a learner. It is best for the teacher to just wait quietly during wait time, and not interrupt learners’ cognition with commentary (Rowe 1972). However, if a teacher sees that more hands are not going up, he/she may determine learners need a prompt to think (Stahl, R. 1994).

The teacher can ask learners to:

- Use a tool in the classroom environment to help find the answer (e.g., point to a visual aid, such as a number line, on the wall, or say, “check the drawing in your exercise book from yesterday”)
- Turn and tell a friend their answer
- Write down the answer

In a community of learning activity at school, teachers could be tasked by a head teacher to train colleagues on wait time. They could read about wait time in their self-study teacher training module, practice in the classroom and prepare an interactive 30-minute training activity for their colleagues where they introduce the concept, share the results of giving wait time, and facilitate a practice activity, such as "The Wait Time Skit" (see end of chapter). When coaches and instructional leaders set teachers up in this kind of peer-led learning, richer dialogue and real uptake often occur, as colleagues are more likely to "show up" for each other in meaningful ways and are motivated by opportunities to shine.

Grade three learners in Uganda raise their hands one after another as "wait time" gives more opportunities to respond.

Practitioner's Connection: Increase Uptake with Practical, Low Stakes Opportunities for Teachers to Practice Effective Teaching Techniques

In classrooms with high student-to-teacher ratios and very limited resources, conducting large-scale targeted instruction at each learner's instructional level is often not feasible. However, supporting teachers to use effective teaching techniques is a smart entry point for making existing grade-level competence-based teaching and learning materials a few degrees more tailored to learners' needs. Below, we hear from Nzabambizi Slyivie, a grade 1 teacher who works with USAID Rwanda Soma Umenye, explain how the new methodology and skills she acquired during remedial reading camp have transferred to her approach to classroom instruction.

"In Kinyarwanda Reading Camp [KRC], we taught students writing and reading activities through different games, songs, picture cards, flash cards, as well using local materials (e.g., bottle tops). I saw that these activities supported learners to easily identify letters and syllables and, since they enjoyed the activities, I now use them in my regular Kinyarwanda lessons. KRC supported me to know how to identify, group, and support struggling learners as well as provide leveled readers, activities, and exercises to different students. This is a skill I take to all my regular lessons where I have many students with different levels."

Effective Teachers Adapt Versions of the "Cold Call"

The technique commonly codified as the "Cold Call" (Christensen Center for Teaching and Learning, 2021) was adapted to the term "Everyone Can Answer" by the USAID Soma Umenye team in Rwanda. The term "Everyone Can Answer" felt friendlier than "Cold Call" and reinforced the belief that every learner has something to important to offer. A recent study (Dallimore, Hertenstein, and Platt, 2013) reflects how effective teachers who set the expectation that all learners must answer when called on increase participation and inclusion. The term "cold call" refers to the technique where teachers intentionally call on learners who did not raise their hand or volunteer an answer. However, teachers must be thoughtful and loving when they call on a learner this way and have another technique "in their pocket" to support the learner. In a mathematics classroom where learners know that anyone can be called on at any time to answer, learners must trust that the teacher is asking them for an answer because she believes:

1) The learner can answer, and

2) The learners' contributions are valuable and important.

Be ready to help the student find an answer. ***Do not*** use this technique to embarrass a learner who is off task or to trigger anxiety from an overly public struggle with the content of the lesson. Education practitioners often raise concern about this technique; however, research has proven that cold calling done right increases the number of learners who voluntarily answer questions, that individual learners answer more questions in classes where this technique is the norm, and participate in discussion more than in classes with low incidence of cold calling (Dallimore, 2013).

Practitioner's Connection: Use effective teaching techniques to affirm math identities

This three-generational discussion about math identities between daughter and T2TGlobal staff member, Suhaihah Waheed, her mother, STEM [science, technology, engineering, and mathematic] educator Shawn Muslim, and grandmother Dr. Elvira Williams, the first woman in North Carolina to earn her PhD in physics, is a great way begin to understand how inclusion of underrepresented groups leads to collective strength. These educator advocates dialogue on the influences that developed their math identities and share reflections on how quality math education is a driver of social justice that can serve and solve problems for everyone.

Effective Teachers Adapt Versions of "No Opt Out" to Provide an Assist

Sometimes when a learner is asked to respond to a question, or cold-called, they do not have an answer. Teachers should never accept no answer, or an incorrect answer then move on without getting to a right one. Doing so does nothing to affirm a positive mathematical identify of that learner, and covertly communicates that the teacher does not believe they can answer. It also sends the message that stopping with an incorrect answer instead of learning from it is acceptable, and can confuse the other learners who have the correct answer but weren't called on. Helping the learner get to the correct answer should be done lovingly and sets the expectation that everyone can answer.

For example, if a learner gets stuck a teacher can respond by providing an assist such as:

- Give the correct answer, then prompt learner to repeat the answer, which sounds like:
  Teacher: Maria Teddy, what is 4 plus 5?
  MT: (silent, no answer)
  Teacher: Four plus five is nine. Maria Teddy, what is four plus five?
  MT: Nine
  Teacher: Thank you. Opio, what is five plus five?
- Give a clue to help learner find the answer, then prompt the leaner to give the answer.
- Call on another learner to give the correct answer, then prompt the first learner to repeat the answer.
- Call on another learner to give a strategy to get the correct answer. The first learner tries the strategy and gives an answer.

These interactions between learner and teacher in a whole class scenario take just a few seconds and are practical ways to affirm mathematical identities and cope with large class sizes. The teacher does not have to prepare extra materials or complicated modifications to a lesson plan but should provide

scaffolding that supports the learner to answer the question, even with an assist from the teacher or another learner.

Effective Teachers Support Learners to Get It Right

Effective teachers use kind words to prompt learners to give better or more complete answers. Teacher confidence with this technique is important, as sometimes teachers feel that they will shame or embarrass a student who gives an incorrect or a partially correct answer, so they will simply move on. This can reinforce learner misconceptions and take up valuable instructional minutes to clarify if a wrong answer goes unaddressed or gets glossed over.

Scenarios where a learner gives an answer that is relevant, but does not actually answer the question asked can sound like:

> **Teacher says:** In your own words, what is the definition of denominator? (Calls on student.)
>
> **Learner says:** In the fraction 3/4 the denominator is 4.
>
> **Teachers says:** Yes, 4 is an example of a denominator in the fraction 3/4, but I'm asking you for the definition of a denominator. Can you explain it in your own words?
>
> **Learner says:** Oh! A denominator is the number that is all the parts of a whole.

If a learner gives an incorrect or incomplete answer, an effective teacher might say, “I want you to ask the learner next to you what they think, then I will come back to you and see if you can adjust your answer.” If a learner gives an answer that does not match the question, but has some importance, an effective teacher might say, “Think again. You gave me an answer for a question with the numbers 6 and 2. You said 8, but that is not the answer for the question on the board. Can you check the symbol and answer it again?” Another common version of “getting it right” is asking learners to give their answer again in a complete sentence or to repeat the answer including the units if units were omitted in the first response.

Practical Techniques for Language Learners in Math Class

Instructional strategies include various strategies or tools that make practicing numeracy skills more accessible and mathematics content more comprehensible. Some examples include: building background, employing explicit and implicit vocabulary techniques, doing Think Alouds; posting sentence frames as visual aids and prompting learners to use them, and sometimes including a language objective that supports the content objective of a planned lesson or activity (Echevvaria, Vogt, and Short, 2012). However, if these strategies or tools are not currently built into instructional models, there are also effective teaching techniques using existing materials that teachers can use to support learners in the classroom.

Effective Teachers Give Clear Directions and Non-verbal Cues

Effective teachers can modify lessons by using non-verbal cues and stripping out unnecessary or confusing words. Below, we present an example of two teaching strategies to demonstrate effective and inclusive teaching techniques, contrasting Teacher 1 with Teacher 2. For this example, it is important to note that 1) while this moment is teacher-led, every “teacher move” is learner-centered, and 2) while the task rigor stays the same, the results the teacher sees when marking the exercises are likely to be very different. In this example, Teacher 1 is likely to gather less feedback about how students are solving problems and see more wrong or incomplete answers. Teacher 2 is likely to see if his/her students are

picking up on key words and associating them with the right operation, as well as getting more correct and complete answers.

Example 1: Teacher working with students in their first language	**Example 2:** Teacher working to intentionally accommodate learners in their first, second and third languages
Story problem: Prossy brought 10 chapatis to sell at the market. Market day is every Tuesday. By the end of the morning Prossy has sold six chapatis. How many chapatis remain?	
There are story problems on the chalkboard that you should copy into your exercise book. Make sure you draw a picture for each exercise to show your strategy for finding the answer. You will do number one with a partner, numbers two and three independently. If you get stuck on a problem, raise your hand and I will come and help you.	Take out your exercise books so we can practice. (Holds up exercise book.) Please copy the first story problem on the board. (Points to story problem, waits.) Let's practice the steps to finding a solution together. I will "think aloud." First, I will read the problem. (Reads problem.) Then I will circle any important numbers or words. (Circles numbers and the words "brought" and "sold".) Do it with me. (Waits for learners to circle words in exercise books.) In this story I think the word "sold" means to subtract. (Writes a subtraction sign above the word sold.) Now I will write the story in numbers. (Writes 10 – 6 =?) Now I will solve 10 take away 6, and I think I will use my fingers check. (Models holding up 10 fingers and puts down 6. Counts to 4.) I know that if 6 chapatis were sold out of 10, then Prossy has 4 chapatis left. So, the answer is 4 chapatis remain. I will write that on the board, and you will write it in your exercise book. Can you repeat these steps in your exercise books now for the exercises 2 (points to the second problem on chalkboard) and 3 (points to third problem on chalkboard)? I will move around as you work to see what great problem-solvers you are.

Ongoing Teacher Support Through a Continuum of Practice

Instructional leaders and coaches can use a variety of instruments to support teachers through different types of observation exercises. Here, we share some examples of instruments and activities used to promote practice of Wait Time in Tajikistan and Rwanda that have demonstrated teacher uptake of effective teaching techniques.

Example 1: Focused observation protocol to establish baseline, midline, and endline results for teacher behavior change on the uptake of Wait Time techniques.

Teacher_____	**Observer**_____	
School _____	**Class** _____	**Date** _____

Purpose This observation supports teacher's to increase the amount of wait time and the variety of ways wait time is given; 1) time to think, 2) using visual aids, book, notes or clues, 3) turn and talk or think-pair-share, 4) write it, or 5) other techniques. ***Directions*** Record each opportunity to use wait time during the minutes of instruction you observe. Count the opportunities used and missed and analyze the findings. Discuss with the teacher to reflect and identify next steps.

Recording Section: Wait Time

Opportunity #1:	Yes, five or more seconds were given for: • Time to think • Prompted or cued students to use a visual aid, refer to book or notes • Turn and talk or Think-pair-share • Writing down thoughts • Other _____
	No. The teacher used: • Call and response • Called on student/s within 5 seconds • Other _____
Opportunity #2:	Yes, five or more seconds were given for: • Time to think • Prompted or cued students to use a visual aid, refer to book or notes • Turn and talk or Think-pair-share • Writing down thoughts • Other _____
	No. The teacher used: • Call and response • Called on student/s within 5 seconds • Other _____
Opportunity #3:	Yes, five or more seconds were given for: • Time to think • Prompted or cued students to use a visual aid, refer to book or notes • Turn and talk or Think-pair-share • Writing down thoughts • Other _____
	No. The teacher used: • Call and response • Called on student/s within 5 seconds • Other _____
Opportunity #4:	Yes, five or more seconds were given for: • Time to think • Prompted cued students to use a visual aid, refer to book or notes • Turn and talk or Think-pair-share • Writing down thoughts • Other _____
	No. The teacher used: • Call and response • Called on student/s within 5 seconds • Other _____

Quantify and Analyze the Data

How many opportunities for wait time were there?	
How many opportunities were used?	
Number of time to think	
Number of prompts or clues	
Number of turn and talk or T-P-S	
Number of write it down	
Number of other	
What wait time strategies could have been used in instances where no wait time was given?	

Reflection and Next Steps

Example 2: Sample of a content-based focused observation form where the observer (peer or coach) acts as a mirror to reflect back to the teacher her action and learners' actions in the course of a lesson. The form includes space at the top to note taken — or missed — opportunities.

Friendly Peer Content Based Observation Form: Instructional Model B

Teacher:	Observer:	Date:	Time:

Class Culture

Make note of opportunities taken or missed to use the following techniques:

Positive Framing/Precise Praise	**Wait Time/No Opt Out/Right is Right**	**Culture of Error/Emotional Constancy**

Instructional Sequence

Content Objective:

Language Objective:

Step	**Notes on Teacher/Learner Activities**
Building Background Key Words (SVI) Sentence Frames	
I Do Think Aloud Modeling	
We Do	
You Do	
Assessment Checks for understanding Exit ticket	

Glows:

Grows:

Next Steps:

Wait Time Skit Materials

Facilitator Materials: Wait Time Role Play

Facilitator Preparation and Directions

Before the training activity, cut out the flash cards to use as the instructional activity. Print out and cut or write the description of each role below onto separate pieces of scratch paper. Find eight willing participants and give them each a role to play:

- **Teacher #1:** Gives no wait time, always calls on the first or second hand to go up
- **Teacher #2:** Gives 5-10 seconds of wait time, calls on a variety of students
- **Student #1:** Immediately raise your hand for every question, say “teacher, teacher!” Give a wrong answer when called on.
- **Student #2:** Wait for 3 seconds, then raise your hand. Give a correct answer if called on.
- **Student #3:** Wait for 5 seconds, then raise your hand. While you are waiting, count on your fingers to find the answer. Give a correct answer if called on.
- **Student #4:** Never raise your hand. If the teacher calls on you, give a correct answer.
- **Student #5:** Wait for 8 seconds, then raise your hand. Give a correct answer if called on.
- **Student #6:** Wait for 10 seconds, then raise your hand. Give a correct answer if called on.

Directions

1) When you give the participant the small paper with their role, make sure to tell them not to show anyone; it is top secret.
2) Give Teacher #1 the math fact flash cards.
3) Ask the role players to come to the front of the room and conduct the role play.
4) After about 10 flash cards, tell the role players to stop. Ask Teacher #1 to step out, and Teacher #2 to step in.
5) Tell participants that now they will observe the same lesson with the same students, and that only the teacher is different.
6) Tell role players to begin again.
7) After about 10 flash cards, tell the role players to stop.

   Ask participants:

   - What was the difference between Teacher #1 and Teacher #2?
   - How many learners were participating when Teacher #1 was teaching?
   - How many learners were participating when Teacher #2 was teaching?

   Ask the student role players:

   - What did it feel like to be with Teacher #1?
   - What did it feel like to be with Teacher #2?

   Ask all participants:

   - What teaching technique made the difference for more engagement and time on task? (Anticipated answers: wait time, teacher waiting for more students to raise their hand, time to think, time to use strategies, not calling on the first hand that goes up.)

Role Play Parts

Teacher #1: Gives no wait time, always calls on the first or second hands raised
Teacher # 2: Gives 5-10 seconds of wait time, calls on a variety of students,
Student #1: Immediately raise hand for every question, say “teacher, teacher!” Give a wrong answer when called on.
Student #2: Wait for 3 seconds, then raise your hand. Give a correct answer if called on.
Student #3: Wait for 5 seconds, then raise your hand. While you are waiting, count on your fingers to find the answer. Give a correct answer if called on.
Student #4: Never raise your hand. If the teacher calls on you, give a correct answer.
Student #5: Wait for 8 seconds, then raise your hand. Give a correct answer if called on.
Student #6: Wait for 10 seconds, then raise your hand. Give a correct answer if called on.

Flash Cards for Wait Time Skit

2+2=	6+2=
3+5=	3+5=
4+4=	1+4=
7+2=	9+1=
8+1=	7+3=