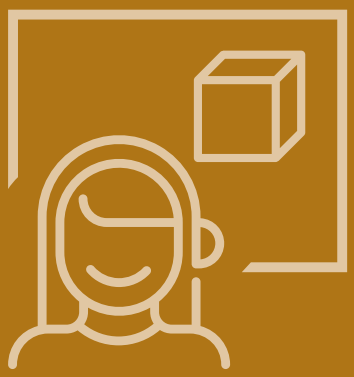
Instructional Approach: Numeracy



INTRODUCTION

High-impact teaching strategies (HITS), also referred to as high-leverage practices, are core pedagogical practices that help students understand content while also supporting their social-emotional development.[1] These teaching practices can demonstrably impact student learning outcomes in both literacy and numeracy.[2]

This mini-guide, one in a series, sheds light on how teachers can apply high-impact teaching strategies, incorporating modeling, explanation, and student exploration, in their instructional approach to numeracy.

HOW TO USE THIS GUIDE

This guide is meant for those who support teacher professional development at the school level. Depending on the local context and approach to professional development, this role can be played by coaches, community of practice leaders, teacher-facilitators, lead teachers, trainers, and Ministry of Education staff working with teachers. As part of a wider professional development approach, this guide can be a tool to target teachers' use of proven strategies to improve student learning in literacy and numeracy.

Teacher professional development has various modalities, ranging from pre-service courses to one-on-one coaching and mentoring to teacher-led communities of practice. This guide is intended to support professional discussions across a variety of contexts: in-school coaching, communities of practice, and pre- or in-service training. Teachers and coaches can use the guide as part of an individualized professional development plan; teacher-facilitators can use it to drive discussion on high-impact strategies as part of a community of practice; and pre-service designers can incorporate it into their curriculum for teacher training. Finally, this guide reflects the incremental progression that teachers follow in their professional growth.

This mini-guide for Instructional Approach to Numeracy, along with the others in the series, reflects the strategy domains and the HITS presented in the following table.

Finally, when adapting the content and use of this mini-guide to the local educational context, it can be integrated into a structured pedagogy program already in place. The mini-guide can be linked directly to the curriculum and teaching and learning materials, and supported through the existing professional development model.

1 Ball & Forzani (2010).
2 Ambrose et al. (2010); Danielson (2022); Rosenshine (2012).

HIGH-IMPACT TEACHING STRATEGIES (HITS)				
Strategy domains		**Tier 1: Basic strategies**	**Tier 2: Developing strategies** *(built upon Tier 1 strategies)*	**Tier 3: Advanced strategies** *(built upon Tier 1 and 2 strategies)*
Learning Environment		Teacher establishes clear **rules and routines** to support learning and create a positive learning environment.	Teacher uses and supports **positive interactions** in the classroom (teacher-student and student-student).	Teacher organizes students to work in **pairs and small groups** to enhance collaboration, to build teamwork, and to promote a sense of belonging.
Student Engagement in Learning		Teacher gives all students, including pairs/small groups, **regular time for the practice of new skills**.*	Teacher uses **questioning** to build and deepen student understanding of new content.	Teacher plans for the strategic use of **partner and small-group work** for collaborative learning activities.**
Knowledge Progression and Connections		Teacher plans with and states the **lesson objective** and links new content to **students' background** (prior knowledge).	Teacher provides a **daily review** and links content to **previous learning**.	Teacher purposefully **sequences** lesson objectives and **adjusts the teaching sequence** as needed.
Assessment-Informed Instruction		Teacher routinely **monitors learning** by checking for understanding during instruction and giving actionable feedback to students.	Teacher **modifies content and instructional strategies** based on evidence of learning collected through formative assessment.	Teacher provides **differentiated instruction and remediation** to address learning gaps.
Instructional Approach	**Numeracy**	Teacher **provides explicit models and explanations** of math concepts and skills, followed by **student practice** of modeled skills.	Teacher uses questioning and other **interactive approaches to build student understanding** when **modeling and explaining** math concepts and skills. *Modeling/explanation is followed by student practice.*	Teacher provides **opportunities for students to explore** concepts and then **draws on their ideas when modeling and explaining** concepts and their application.
	Literacy	Teacher provides **explicit models and explanations** of new skills and concepts, followed by **student practice** of modeled skills.	Teacher **adds activities** to **construct meaning (or build knowledge)** together with students.	Teacher gives students **opportunities to apply skills in meaningful ways**.

Notes:
*Tier 1: Teacher groups students to engage all children in the learning activity, especially when materials are being shared.

**Tier 3: Teacher purposefully groups students to engage all children through homogenous or heterogenous grouping. Homogenous grouping can be used with students working at a similar, medium level to learn at a higher level together. Heterogeneous grouping is used to provide peer support to students who may be struggling with new content and skills.

Recognizing that professional development is most effective when it is focused and incremental, this guide proposes a tiered approach to mastering a collection of strategies, as shown in the table. Professional development activities that support teachers, especially those working in low- and middle-income countries, in mastering the specific strategies listed under Tier 1 are likely to result in improved instruction and learning outcomes. As teachers master the basic strategies of Tier 1 and move toward the more "advanced" Tiers 2 and 3 in each category, they will be empowered with a full set of strategies to reach and support more students. Over time (as measured in years, as opposed to weeks or months), a professional development program that follows a tiered approach can help teachers move toward more depth of instructional mastery (higher tiers) and significantly improve the quality of their teaching, which will ultimately help more students develop a deeper understanding and mastery of foundational literacy and numeracy skills and concepts.

It is important to note that not all teachers will start at Tier 1. Depending on the teacher's level of experience and familiarity with implementing the strategies, she may start at Tier 2 or even Tier 3. Furthermore, a teacher starting at Tier 2 within the Learning Environment domain may start at Tier 1 in the Knowledge Progression domain; this type of variation and personalization is a key component of this guide and reflects each teacher's individual journey within classroom practice. Each guide includes a decision tree that includes helpful questions about teacher practices and the learning environment to help you decide on how best to work with the teachers you support.

DOMAIN:

Instructional Approach to Numeracy

WHY DOES IT MATTER?

There are multiple instructional approaches to teaching math concepts and skills to students. Research has shown the benefit of teachers explaining clearly what the learning objective is, modeling and providing clear explanations of new concepts, and allowing ample time for students to practice new skills and concepts.[3] Research has also shown that engaging students in exploratory activities, discussions, and questions improve student understanding of concepts and ability to apply them.[4] Teachers scaffold student learning as they move through the learning process and give guided support as required.

Read more about math instructional strategies here.

WHERE TO START?

As mentioned earlier, not all teachers will start on the same tier for a given domain. The decision tree below is designed to help meet teachers where they are and support them in implementing these strategies at their own pace. There are three different boxes with prompts to help guide your decisions as to which strategy teachers—in individual coaching sessions, in communities of practice, or in pre- and in-service training—should try first and how to determine when teachers are ready to implement a new strategy from the next tier. The strategies are color coded: Tier 1 strategies are listed in green, Tier 2 in blue, and Tier 3 in purple. However, it is important to remember and to convey to teachers that the particular strategies described in this guide are not meant to be a checklist; it takes time to implement new ideas, and teachers may have to work on a strategy over several days, weeks, or months before feeling confident in using them and before students start benefiting from them.

Decision Tree

The decision tree below can help teachers identify which strategies to begin with and help those who support their professional development focus their support. Starting with Box 1, teachers can discuss the questions listed to check whether they already implement that strategy. As they proceed through the subsequent boxes in the decision tree, when they reach a strategy that is new to them or they believe needs improvement, teachers work on the strategy noted in that box.

Teachers and those who support them can also gauge what type of strategies they use in the classroom by discussing questions such as the following:

- Do you use a teacher's guide or refer to materials provided during a math training when teaching math concepts?
- What other resources do you use to plan your math lessons?
- How do you involve students when you teach math concepts?

3 Victoria State Government (2020).
4 Sitabkhan et al (2019)

TIER 1

Do teachers provide explicit models and explanations of math concepts and skills, followed by student practice?

Teachers can discuss the following questions:

- Why is it important to model and explain a concept or skill step by step for students?
- How do you clearly explain the concept or skill?
- How do you prepare to model the concept or skill? What representations can be used to model it?

If teachers understand the importance of modeling and explanation and use it in their teaching, they can move on to Tier 2.

If teachers introduce new concepts or skills to the class but do not model them, provide clear explanations, or use appropriate representations, they can continue working on Tier 1.

After a few weeks, teachers can assess their progress on these strategies and determine whether they are ready to move on to the next tier.

TIER 2

Do teachers use questioning and other interactive approaches to build student understanding when modeling and explaining math concepts and skills?

Teachers can discuss the following questions:

- Why is it important to encourage student questioning during the modeling and explanation of concepts and skills?
- What kinds of questions can you ask students during the explanation?
- What other ways can you encourage student participation during the explanation?

If teachers incorporate questioning and other interactive approaches, they can move to Tier 3.

If teachers do not encourage interactive approaches, they can continue working on Tier 2.

After a few weeks, teachers can assess their progress on these strategies and determine whether they are ready to move on to the next tier.

TIER 3

Do teachers provide opportunities for students to explore concepts and then draw on their ideas when modeling and explaining concepts?

Teachers can discuss the following questions:

- Why is it important for students to have time to explore the concepts themselves?
- What are examples of good problems to use to encourage explanation?
- What types of questions can you ask to encourage student explanation?
- How do you know when students are struggling with new concepts or skills? What can you do to address this?

If the teachers show an understanding of how to use this strategy, they can share their practices with others and continue the discussion.

If teachers do not help explore concepts and then draw on their ideas during the explanation, they can continue to work on Tier 3.

STRATEGIES FOR THE MATH CLASSROOM

The tiered strategies below can be used with students across the early primary grades and adapted for the upper grades. For each tier, two examples are provided for how the strategy might be applied for different topics. Teachers may need to adjust the strategy from the way it is described to work with a specific grade or group of children. The strategies in this mini-guide are written with the classroom teacher in mind, even though, in most cases, coaches or teacher learning facilitators will be the ones sharing the strategies with teachers. Whether it is providing printed handouts or discussing the strategies together, the coach can decide the best way to share them with teachers.

Each of the strategies corresponds to one of three tiers:

Green: TIER 1

Blue: TIER 2

Purple: TIER 3

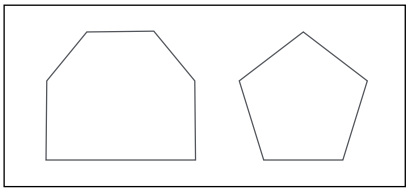
TIER 1: Teacher provides explicit models and explanations of math concepts and skills, followed by student practice of modeled skills.

Applying the strategy: Example 1 ***Topic: Introduction to adding with unknowns (5 + __ = 8)***	
Providing strong and clear models and explanations of content can scaffold new concepts for students. Teachers can use multiple representations to demonstrate concepts and build student understanding. Following modeling, students should always be given ample opportunity to practice the targeted skills. In this example, students have been learning about addition and subtraction for many months and are able to add and subtract numbers up to 10. The next several lessons focus on identifying the unknown whole number in an addition or subtraction equation. For example, 5 + ___ = 8.	
1.	The teacher writes the problem *5 + __ = 8* on the board. She first explains what the problem is by asking, *Five plus what equals eight? Then she uses a strategy to solve the problem, explaining each step as she does it. For example: I know that I need to find which number added to 5 will make 8. One way I know how to do this is to count up using my fingers. I put up 5 fingers, then count: 6, 7, 8. The answer is 3 fingers. 5 plus 3 equals 8.* Or the teacher may model how to solve the problem a different way.
2.	The teacher then writes a similar example on the board, and again clearly explains how to solve the problem.
3.	The teacher asks students to now try to work on similar problems. She writes five similar problems on the board and asks students to solve them independently.

Applying the strategy: Example 2
Topic: Attributes of shapes

Providing strong and clear models and explanations of content can scaffold new concepts for students. Teachers can use multiple representations to demonstrate concepts and build student understanding. Following modeling, students should always be given ample opportunity to practice the targeted skills.

In this example, students have been learning about attributes of shapes, including sides and corners.

1.	The teacher draws the two shapes below on the board.  She says, *Today we are going to compare these shapes to find out which shape has more sides and which shape has more corners.*
2.	The teacher models how to find the solution: *First, I will look at the first shape. I'm going to count how many sides this shape has. I remember from our lesson yesterday that these are sides (she touches a side of the shape) and these are corners, where the two sides meet. 1, 2, 3, 4, 5, 6. It has 6 sides.* The teacher does the same for the other shape, and then compares them: *The first shape, a hexagon, has 6 sides. The second shape, a pentagon, has 5 sides. I know that 6 is more than 5, so the hexagon has more sides.* She repeats the same process for the number of corners.
3.	The teacher draws two more shapes on the board and again clearly explains how to compare the number of sides and corners.
4.	The teacher asks students to now try to work on similar problems. She draws four sets of shapes and asks student to figure out which shape has more sides and corners.

TIER 2: Teacher uses questioning and other interactive approaches to build student understanding when modeling and explaining math concepts and skills.

Applying the strategy: Example 1
Topic: Introduction to adding with unknowns (5 + ___ = 8)

As part of providing clear models and explanations, teachers can use questioning or other interactive approaches to deepen students' conceptual understanding by drawing on and linking to their prior knowledge and understanding and engaging them in building the model or explanation.

This example shows how to integrate questioning and interactive approaches into a lesson focused on identifying the unknown whole number in an addition or subtraction equation. Students would have been learning about addition and subtraction previously and are able to add and subtract numbers up to 10.

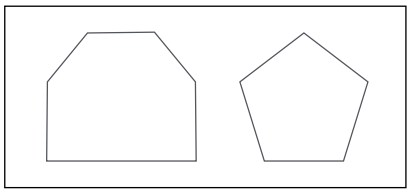
1.	The teacher writes the problem *5 + __ = 8* on the board.
2.	She asks students to help her solve the problem: *Can anyone tell me what this problem is asking us to do? Who can "read" the number sentence?* A student might say, *5 plus what makes 8.* The teacher then builds on what the student says, using their answer in her explanation. The teacher asks, *5 plus what number makes 8?* She might take various answers from students. She then discusses which one is correct and why, focusing on how a particular answer was found and explicitly explaining each step needed to get to the correct answer.
3.	Then the teacher models a similar problem in the same way, soliciting student participation.

4.	The teacher asks students to now try to work on similar problems. She writes five similar problems on the board and asks students to solve them independently.

Applying the strategy: Example 2
Topic: Attributes of shapes

As part of providing clear models and explanations, teachers can use questioning or other interactive approaches to deepen students' conceptual understanding by drawing on and linking to their prior knowledge and understanding and engaging them in building the model or explanation.

In this example, students have been learning about attributes of shapes, including sides and corners.

1.	The teacher draws the two shapes below on the board.  She says, *Today we are going to compare these shapes to find out which shape has more sides and which shape has more corners.*
2.	The teacher solicits student input to solve the problem: *First, let's compare the sides. Who can show me what a side is on this shape?* A student comes up to the front of the classroom to touch a side. The teacher confirms and shares with students the definition of a side. The teacher then asks another student to come and count how many sides each shape has. The teacher then asks, *Class, which shape has more sides? How do you know?* Students share that the hexagon has more sides than the pentagon. The teacher confirms and explains why the hexagon has more sides than the pentagon. The teacher repeats this activity with the corners.
3.	The teacher draws two more shapes on the board and again solicits student input to determine which shape has more sides and corners.
4.	The teacher asks students to now try to work on similar problems. She draws four sets of shapes and asks student to figure out which shape has more sides and corners.

TIER 3: Teacher provides opportunities for students to explore concepts and then draws on their ideas when modeling and explaining concepts and their application.

Applying the strategy: Example 1
Topic: Introduction to adding with unknowns (5 + __ = 8)

In mathematics learning, allowing students to explore mathematical questions and to use their prior knowledge to grapple with new problems before providing a model or explanation can contribute to deeper conceptual understanding, motivate students, and help them see that they can succeed in mathematics.

In this example, the teacher provides students with the opportunity to explore a problem on their own and then uses their strategies and ideas—while correcting any misconceptions—to provide a model. She then provides opportunities for further practice.

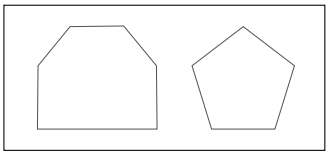
1.	The teacher writes the problem *5 + __ = 8* on the board.
2.	She asks students to work in pairs to try to solve the problem on the board. She provides three to five minutes for the students to work.

3.	When the time is up, the teacher asks some students to share their answer. She asks follow-up questions, such as *Why do you think the answer is 3? How did you get your answer?* If the teacher receives incorrect responses, she can ask questions that help the students arrive at the solution. The teacher then uses the students' answers to restate the solution clearly.
4.	The teacher models a similar problem, referring to strategies that the students used to solve the previous problem.
5.	The teacher asks students to now try to work on similar problems. She writes five similar problems on the board and asks students to solve them independently.

Applying the strategy: Example 2
Topic: Attributes of shapes

In mathematics learning, allowing students to explore mathematical questions and to use their prior knowledge to grapple with new problems before providing a model or explanation can contribute to deeper conceptual understanding, motivate students, and help them see that they can succeed in mathematics.

In this example, the teacher provides students with the opportunity to explore shapes and their properties. She then uses their observations and ideas—while correcting any misconceptions—to provide a model and explanation. She then provides opportunities for further practice.

1.	The teacher draws the two shapes below on the board.  She says, *Today we are going to compare these shapes to find out which shape has more sides and which shape has more corners.*
2.	She asks students to work in pairs to try to solve the problem on the board. She provides three to five minutes for all students to work.
3.	When the time is up, the teacher asks some students to share their answer. She asks follow-up questions, such as *Why do you think this shape has more sides? How did you get your answer?* If the teacher receives incorrect responses, she can ask questions that help the students arrive at the solution. The teacher then uses the students' answers to restate the solution clearly.
4.	The teacher models a similar problem, referring to strategies that the students used to solve the previous problem.
5.	The teacher asks students to now try to work on similar problems. She writes five similar problems on the board and asks students to solve them independently.

REFERENCES

Ambrose, S., Bridges, M., DiPietro, M., Lovett, M., & Norman, M. (2010). *How learning works: 7 research-based principles for smart teaching*. Josse-Bass. https://firstliteracy.org/wp-content/uploads/2015/07/How-Learning-Works.pdf

Ball, D., & Forzani, F. (2010). Teaching skillful teaching. *Educational Leadership: Journal of the Department of Supervision and Curriculum Development*, 68, 40–45. https://www.ascd.org/el/articles/teaching-skillful-teaching

Danielson, C. (2022). *The framework for teaching: At a glance*. Danielson Group.

Rosenshine, B. (2012). Principles of instruction: Research-based strategies that all teachers should know. *American Educator*, Spring, 12–19. https://www.aft.org/sites/default/files/Rosenshine.pdf

Sitabkhan et al., "Instructional Strategies for Mathematics in the Early Grades," 2019. https://ierc-publicfiles.s3.amazonaws.com/public/resources/Maths_Strategies_Final.pdf

Victoria State Government. (2020). *High impact teaching strategies: Excellence in teaching and learning*. Department of Education and Training. https://www.education.vic.gov.au/Documents/school/teachers/support/high-impact-teaching-strategies.pdf

AUGUST 2024

Authored by: Yasmin Sitabkhan, Shirin Lutfeali, Wendi Ralaingita, and Elizabeth Long