

Introduction

Ms. Adrien Paulson assembles her kindergarteners on the rug and engages them with a few questions to kick off her mathematics block. She asks her young learners what they are learning in mathematics this week. Without hesitation, they respond, “We are learning to represent and recognize numbers.” She then asks the follow-up question, “Why are we learning to represent and recognize numbers?” Again, without hesitation, her learners call out, “So we can use them to solve problems.” Finally, she asks her learners how they will know they can represent and recognize numbers. As before, they respond, “We can use our tens frames and show our friends how to solve problems.” In Ms. Paulson’s classroom, the learning for the day is visible to her students. They know the *why* behind their learning and what success will look like at the end of today’s mathematics block.

Skipping ahead to the spring of the same academic year, we encounter a young learner named Tessa. Tessa is a quiet kindergartener who loves school, and mathematics is no exception. Over the span of 1 academic year, she has developed the skill and will to ask her friends to “give me a hard math problem.” Eight plus seven, three times four, and five minus two are really no challenge for Tessa. She quickly rattles off the sum, product, and difference between two numbers.

Tessa demonstrates a high level of proficiency, or mastery, in procedural fluency and knowledge in the area of computation involving the basic operations with single-digit whole numbers (e.g., number combinations). However, there is more to Tessa’s mathematics learning than her mastery of number facts. Tessa possesses a balance of conceptual understanding, procedural knowledge, and the ability to apply those concepts and thinking skills to different mathematics problems. By

Teaching Takeaway

Learners should expect at least 1 year’s worth of growth in 1 year of formal school.

Teaching Takeaway

Procedural fluency comes from balanced mathematics teaching and learning.

balance, we mean that no one dimension of mathematics learning is more important than the other two. Conceptual understanding, procedural knowledge, and the application of concepts and thinking skills are each essential aspects of learning mathematics. Tessa's prowess in addition, multiplication, and subtraction of single-digit numbers is not the result of her teachers implementing procedural knowledge, conceptual understanding, and application in isolation, but through a series of linked learning experiences and challenging mathematical tasks that result in her engaging in both mathematical content and processes.

If you were to engage in a conversation with Tessa about mathematics, you would quickly see that she is able to discuss the tools and strategies for tackling more complex and difficult problems. For example, Tessa decided to tackle a problem involving goats on a local farm. As Tessa travels to and from school, she passes a farm with goats. While waiting for the traffic light to turn green one day, she counted 23 goats in the field. Ms. Paulson recalls this particular experience because Tessa constructed a sentence about the 23 goats in her writing journal. The next day, she reported that she only observed 14 goats in the field. Tessa noted, "I can't do this with my fingers or in my head. Ms. Paulson, can I use the tens frames to figure out how many goats are missing?" Tessa recognizes that she can use tens frames as a tool to solve the goat problem. Furthermore, she applies a thinking strategy to identify how many goats were missing from the field ("I can make 23 with my tens frames and keep pulling out counters until I only have 14 counters left."). Her learning progression from recognizing and representing numbers to using tools and strategies to solve more complex and difficult mathematics problems comes from the purposeful, deliberate, and intentional decisions of Ms. Paulson. For example, Ms. Paulson makes sure that the learning is visible to her kindergarteners each and every day as they balance conceptual understanding, procedural knowledge, and the application of concepts and thinking. All of Ms. Paulson's decisions focus on the following:

- *What works best* and *what works best when* in the teaching and learning of mathematics, and
- Building and supporting assessment-capable visible learners in mathematics.

This book explores the components in mathematics teaching and learning for grades K–2, with the lens of *what works best* in student learning at the surface, deep, and transfer phases. We fully acknowledge that not every student in your classroom is like Tessa. Our students come to our classrooms with different background knowledge, levels of readiness, and learning needs. Our goal is to unveil what works best so that your learners develop the tools needed for successful mathematics learning.

What Works Best

Identifying what works best draws from the key findings from Visible Learning (Hattie, 2009) and also guides the classrooms described in this book. One of those key findings is that *there is no one way to teach mathematics or one best instructional strategy that works in all situations for all students*, but there is compelling evidence for certain strategies and approaches that have a greater likelihood of helping students reach their learning goals. In this book, we use the effect size information that John Hattie has collected and analyzed over many years to inform how we transform the findings from the Visible Learning research into learning experiences and challenging mathematical tasks that are most likely to have the strongest influence on student learning.

For readers less familiar with Visible Learning, we would like to take a moment to review what we mean by *what works best*. The Visible Learning database is composed of over 1,800 meta-analyses of studies that include over 80,000 studies and 300 million students. Some have argued that it is the largest educational research database amassed to date. To make sense of so much data, John Hattie focused his work on meta-analyses. A **meta-analysis** is a statistical tool for combining findings from different studies, with the goal of identifying patterns that can inform practice. In other words, a meta-analysis is a study of studies. The mathematical tool that aggregates the information is an effect size and can be represented by Cohen's *d*. An **effect size** is the magnitude, or relative size, of a given effect. Effect size information helps readers understand not only that something does or does not have an influence on learning but also the relative impact of that influence.

Our Learning Intention: To understand what works best in the mathematics classroom in grades K–2.

A **meta-analysis** is a statistical tool for combining findings from different studies, with the goal of identifying patterns that can inform practice.

Effect size represents the magnitude of the impact that a given approach has.



Video 1

What Is Visible Learning for Mathematics?

To read a QR code, you must have a smartphone or tablet with a camera. We recommend that you download a QR code reader app that is made specifically for your phone or tablet brand.

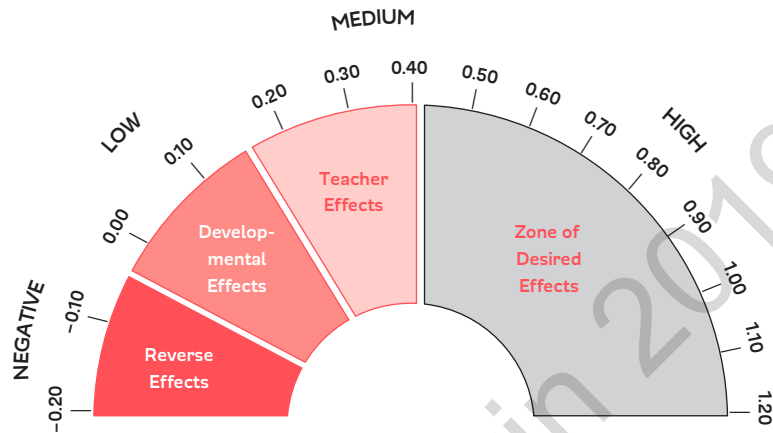
Videos can also be accessed at <https://resources.corwin.com/vlmathematics-k-2>

For example, imagine a hypothetical study in which playing Mozart in the background while learners are engaged in mathematics instruction results in relatively higher mathematics scores among first graders. Schools and classrooms around the country might feel compelled to devote significant resources to the implementation of “thinking music” in all first grade classrooms in a specific district. However, let’s say the results of this hypothetical study also indicate that the use of Mozart had an effect size of 0.01 in mathematics achievement over the control group, an effect size pretty close to zero. Furthermore, the large number of students participating in the study made it almost certain there would be a difference in the two groups of students (those listening to Mozart versus those not listening to Mozart in the background during mathematics instruction). As an administrator or teacher, would you still devote large amounts of professional learning and instructional time on “thinking music”? How confident would you be in the impact or influence of your decision on mathematics achievement in your district or school?

This is where an effect size of 0.01 for the “thinking music effect” is helpful in discerning what works best in mathematics teaching and learning. Understanding the effect size helps us know how powerful a given influence is in changing achievement—in other words, the impact for the effort or return on the investment. The effect size helps us understand not just what works, but *what works best*. With the increased frequency and intensity of mathematics initiatives, programs, and packaged curricula, deciphering where to best invest resources and time to achieve the greatest learning outcomes for all students is challenging and frustrating. For example, some programs or packaged curricula are hard to implement and have very little impact on student learning, whereas others are easy to implement but still have limited influence on student growth and achievement in mathematics. This is, of course, on top of a literacy program, science kits, and other demands on the time and energy of elementary school teachers. Teaching mathematics in the Visible Learning classroom involves searching for those things that have the greatest impact and produce the greatest gains in learning, some of which will be harder to implement and some of which will be easier to implement.

As we begin planning for our unit on number combinations, equality, and addition and subtraction, knowing the effect size of different

THE BAROMETER OF INFLUENCE



Source: Hattie, J. (2009). *Visible learning: A synthesis of over 800 meta-analyses relating to achievement*. Figure 2.4, page 19. New York, NY: Routledge.

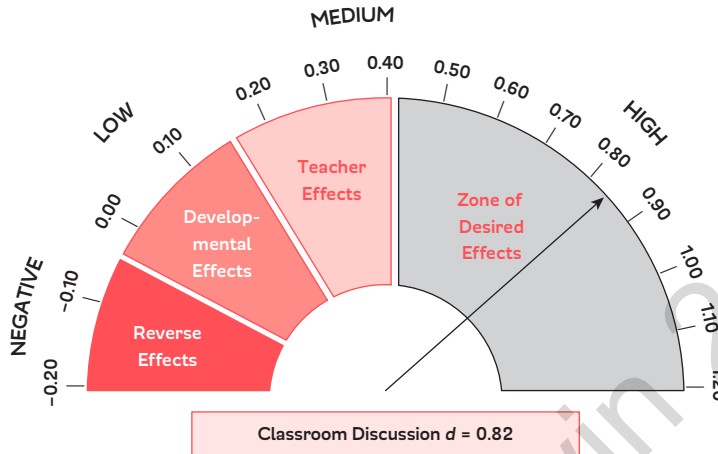
Figure I.1

influences, strategies, actions, and approaches to teaching and learning proves helpful in deciding where to devote our planning time and resources. Is a particular approach (e.g., classroom discussion, exit tickets, use of manipulatives, a jigsaw activity, computer-assisted instruction, simulation creation, cooperative learning, instructional technology, presentation of clear success criteria, development a rubric, etc.) worth the effort for the desired learning outcomes of that day, week, or unit? With the average effect size across all influences measuring 0.40, John Hattie was able to demonstrate that influences, strategies, actions, and approaches with an effect size greater than 0.40 allow students to learn at an appropriate rate, meaning at least a year of growth for a year in school. Effect sizes greater than 0.40 mean more than a year of growth for a year in school. Figure I.1 provides a visual representation of the range of effect sizes calculated in the Visible Learning research.

Before this level was established, teachers and researchers did not have a way to determine an acceptable threshold, and thus we continued to use weak practices, often supported by studies with statistically significant findings.

EFFECT SIZE FOR
ABILITY GROUPING
(TRACKING/
STREAMING)
= 0.12

THE BAROMETER FOR THE INFLUENCE OF CLASSROOM DISCUSSION



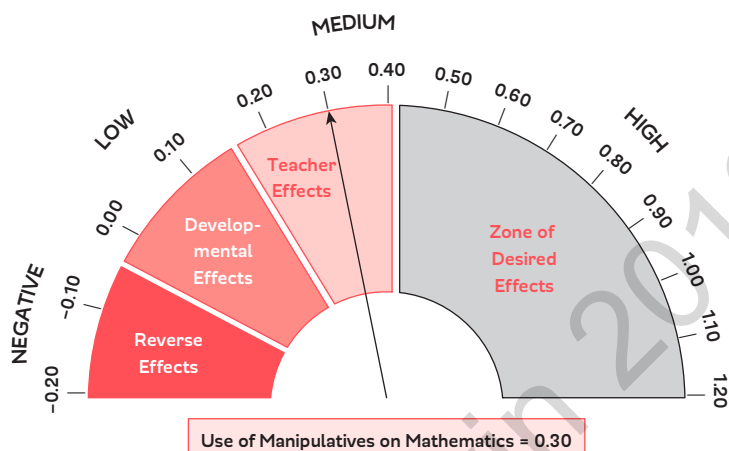
Source: Adapted from Hattie, J. (2009). *Visible learning: A synthesis of over 800 meta-analyses relating to achievement*. Figure 2.4, page 19. New York, NY: Routledge.

Figure 1.2

Ability grouping, also referred to as tracking or streaming, is the long-term grouping or tracking of learners based on their ability. This is different from flexibly grouping students to work on a specific concept, skill, or application or address a misconception.

Consider the following examples. First, let us consider classroom discussion or the use of mathematical discussions (see NCTM, 1991). Should teachers devote resources and time to planning for the facilitation of classroom discussion? Will this approach to mathematics provide a return on investment rather than “chalk talk,” where we work out lots of problems on the board and students then complete worksheets? With classroom discussion, teachers intentionally design and purposefully plan for learners to talk with their peers about specific problems or approaches to problems (e.g., comparing and contrasting strategies for adding and subtracting large numbers versus small numbers, applying properties to find unknown values) in collaborative groups. Peer groups might engage in working to solve complex problems or tasks (e.g., determining the rule for a growing or shrinking pattern). Although they are working in collaborative groups, the students would not be **ability grouped**. Instead, the teacher purposefully groups

THE BAROMETER FOR THE INFLUENCE OF MANIPULATIVE MATERIALS ON MATHEMATICS



Source: Adapted from Hattie, J. (2009). *Visible learning: A synthesis of over 800 meta-analyses relating to achievement*. Figure 2.4, page 19. New York, NY: Routledge.

Figure I.3

learners to ensure that there is academic diversity in each group as well as language support and varying degrees of interest and motivation. As can be seen in the barometer in Figure I.2, the effect size of classroom discussion is 0.82, which is well above our threshold and is likely to accelerate learning gains.

Therefore, individuals teaching mathematics in the Visible Learning classroom would use mathematical discussions to understand mathematics learning through the eyes of their students and for students to see themselves as their own mathematic teachers.

Second, let us look at the use of manipulatives in mathematics and the many conversations about their use. For example, some teachers argue that students “have to learn to do this level of computation without counters.” Other teachers may assert that “if they rely on manipulatives, how are they ever going to learn to do math without them?” Using a barometer as a visual representation of effect sizes, we see that the use

EFFECT SIZE FOR CLASSROOM DISCUSSION = 0.82

EFFECT SIZE OF MANIPULATIVE MATERIALS ON MATHEMATICS = 0.30

of manipulatives has an overall effect size of 0.30. The barometer for the use of manipulatives is shown in Figure I.3.

As you can see, the effect size of 0.30 is below the zone of desired effects of 0.40. The evidence suggests that the impact of the use of manipulative materials on mathematics achievement is low. However, closer examination of the six meta-analyses and the 274 studies that produced an overall effect size of 0.30 reveals a deeper story to the use of manipulatives. Mathematical manipulatives provide opportunities for learners to acquire understanding of mathematical concepts through the manipulation of concrete representations (i.e., counters, tens frames, number lines, fraction tiles, base ten blocks). As learners progress in their conceptual understanding and procedural knowledge, they rely less on these concrete representations because they have now developed fluency in this prior knowledge. In other words, manipulatives provide better learning benefits when used at the right time. This leads us into a second key finding from John Hattie's Visible Learning research: *We should not hold any influence, instructional strategy, action, or approach to teaching and learning in higher esteem than students' learning.*

What Works Best When

Visible Learning in the mathematics classroom is a continual evaluation of our impact on student learning. From the above example, the use of manipulatives is not really the issue and should not be our focus. Instead, our focus should be on the intended learning outcomes for that day and how manipulatives support that learning. Visible Learning is more than a checklist of dos and don'ts. Rather than checking influences with high effect sizes off the list and scratching out influences with low effect sizes, we should match the *best* strategy, action, or approach with learning needs of our students. In other words, is use of manipulatives the right strategy or approach for the learners at the right time, for this specific content? Clarity about the learning intention brings into focus what the

learning is for the day, why students are learning about this particular piece of content and process, and how we *and* our learners will know they have learned the content. Teaching mathematics in the Visible Learning classroom is not about a specific strategy, but a location in the learning process.

Visible Learning in the mathematics classroom occurs when teachers *see* learning through the eyes of their students and students *see* themselves as their own teachers. How do teachers of mathematics see patterns, relational thinking, and the meanings of addition and subtraction through the eyes of their students? In turn, how do teachers develop assessment-capable visible learners—students who see themselves as their own teachers—in the study of numbers, operations, and relationships? Mathematics teaching and learning, where *teachers see learning through the eyes of their learners and learners see themselves as their own teachers*, results from specific, intentional, and purposeful decisions about each of these dimensions of mathematics instruction critical for student growth and achievement. Conceptualizing, implementing, and sustaining Visible Learning in the mathematics classroom by identifying *what works best* and *what works best when* is exactly what we set out to do in this book.

Over the next several chapters, we will show how to support mathematics learners in their pursuit of conceptual understanding, procedural knowledge, and application of concepts and thinking skills through the lens of *what works best when*. This requires us, as mathematics teachers, to be clear in our planning and preparation for each learning experience and challenging mathematics tasks. Using the guiding questions in Figure I.4, we will model how to blend what works best with what works best *when*. You can use these questions in your own planning. This planning guide is found also in Appendix B.

Through these specific, intentional, and purposeful decisions in our mathematics instruction, we pave the way for helping learners see themselves as their own teachers, thus making them assessment-capable visible learners in mathematics.

Teaching Takeaway

Using the right approach, at the right time increases our impact on student learning in the mathematics classroom.

HOW TO USE APPENDIX B WHEN PLANNING FOR CLARITY

I have to be clear about what content and practice or process standards I am using to plan for clarity. Am I using only mathematics standards or am I integrating other content standards (e.g., writing, reading, or science)?

Rather than what I want my students to be doing, this question focuses on the learning. What do the standards say my students should learn? The answer to this question generates the **learning intentions** for this particular content.

Once I have clear learning intentions, I must decide when and how to communicate them with my learners. Where does it best fit in the instructional block to introduce the day's learning intentions? Am I going to use guiding questions?

As I gather evidence about my students' learning progress, I need to establish what they should know, understand, and be able to do that would demonstrate to me that they have learned the content. This list of evidence generates the **success criteria** for the learning.

ESTABLISHING PURPOSE

1

What are the key content standards I will focus on in this lesson?

Content Standards:

2

What are the learning intentions (the goal and why of learning, stated in student-friendly language) I will focus on in this lesson?

Content:

Language:

Social:

3

When will I introduce and reinforce the learning intention(s) so that students understand it, see the relevance, connect it to previous learning, and can clearly communicate it themselves?

SUCCESS CRITERIA

4

What evidence shows that students have mastered the learning intention(s)? What criteria will I use?

I can statements:



This planning guide is available for download at resources.corwin.com/v/mathematics-k-2.

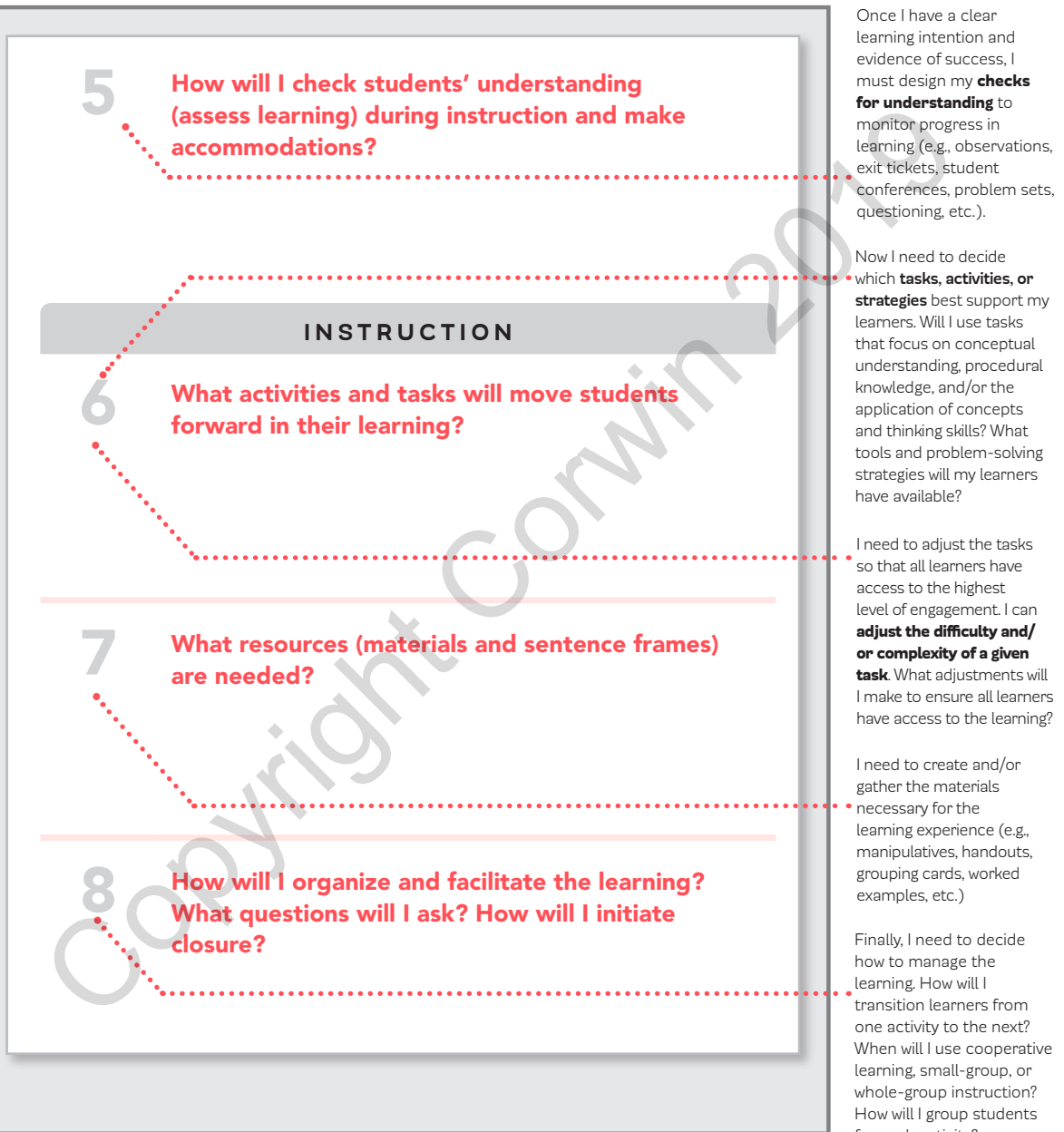


Figure I.4

EFFECT SIZE FOR
ASSESSMENT-
CAPABLE VISIBLE
LEARNERS = 1.44



Video 2
Creating Assessment-
Capable Visible Learners

[https://resources.corwin.com/
vlmathematics-k-2](https://resources.corwin.com/vlmathematics-k-2)

The Path to Assessment-Capable Visible Learners in Mathematics

Teaching mathematics in the Visible Learning classroom builds and supports assessment-capable visible learners (Frey, Hattie, & Fisher, 2018). With an effect size of 1.44, providing a mathematics learning environment that allows learners to see themselves as their own teacher is essential in today's classrooms.

Jackson is an energetic first grader who loves school. He loves school for all of the right reasons—gaining knowledge and having fun. From Jackson's perspective, these two characteristics are not mutually exclusive. During a spiral review to activate prior knowledge, Jackson is engaging in the deliberate practice of comparing two numbers between 0 and 110. During a discussion with his shoulder partner, Jackson talks about his areas of strength and areas for growth: "I am good at smaller numbers, you know, when they are single-digit or double-digit numbers. I get a little messed up when there are three digits and a zero, like 104 and 110. You see, 4 is greater than 0, but you should not look there." This is a characteristic of an assessment-capable learner in mathematics.

Assessment-capable visible mathematics learners are:

1. Active in their mathematics learning. Learners deliberately and intentionally engage in learning mathematics content and processes by asking themselves questions, monitoring their own learning, and taking the reins of their learning. They know their current level of learning.

Later on in the lesson, Jackson is working on solving story and picture problems using addition and subtraction with his cooperative learning group. His group has encountered a challenging problem, $55 + 60$. However, they quickly recognize that they have the tools to solve this problem. One of the group members chimes in, "We can break 55 up into 50 and 5, right? These are more friendly numbers. I am going to do that! The number 55 feels unfriendly." This is a characteristic of an assessment-capable learner in mathematics.

Assessment-capable visible mathematics learners are:

2. Able to plan the immediate next steps in their mathematics learning within a given unit of study or topic. Because of the active role taken by an assessment-capable visible mathematics learner, these students can plan their next steps and select the right tools (e.g., manipulatives, problem-solving approaches, and/or meta-cognitive strategies) to guide their learning. They know what additional tools they need to successfully move forward in a task or topic.

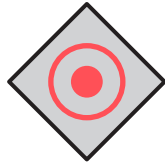
As Jackson's teacher begins to wrap up the day, she has the opportunity to conference with Jackson. His teacher takes time to individually conference with each student at least once a week. This allows her to provide very specific feedback on each learner's progress. Jackson begins the conference by stating, "The practice problems were hard for me." Jackson's teacher engages him in a discussion about how to compare two numbers. Rather than working through examples that Jackson understood, the two of them analyzed examples that Jackson missed on the spiral. He says, "I think I mixed up the places. So, tomorrow, I am going to pick the mathematics center during the morning work block so that I can try this process for finding which number again. You know, the one with the part-part-whole mat. I won't try and do it all in my head." This is a characteristic of an assessment-capable learner in mathematics.

Assessment-capable visible mathematics learners are:

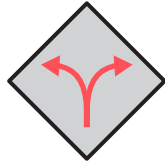
3. Aware of the purpose of the assessment and feedback provided by peers and the teacher. Whether the assessment is informal, formal, formative, or summative, assessment-capable visible mathematics learners have a firm understanding of the information behind each assessment and the feedback exchanged in the classroom. Put differently, these learners not only seek feedback, but they recognize that errors are opportunities for learning, monitor their progress, and adjust their learning (adapted from Frey et al., 2018) (see Figure I.5).

ASSESSMENT-CAPABLE VISIBLE LEARNERS

ASSESSMENT-CAPABLE LEARNERS:



KNOW THEIR CURRENT LEVEL OF UNDERSTANDING



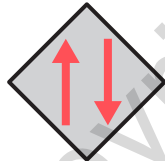
KNOW WHERE THEY'RE GOING AND ARE CONFIDENT TO TAKE ON THE CHALLENGE



SELECT TOOLS TO GUIDE THEIR LEARNING



SEEK FEEDBACK AND RECOGNIZE THAT ERRORS ARE OPPORTUNITIES TO LEARN



MONITOR THEIR PROGRESS AND ADJUST THEIR LEARNING



RECOGNIZE THEIR LEARNING AND TEACH OTHERS

Source: Adapted from Frey, Hattie, & Fisher (2018).

Figure I.5

Over the next several chapters, we will explore how to create a classroom environment that focuses on learning and provides the best environment for developing assessment-capable visible mathematics learners who can engage in the mathematical habits of mind represented in one form or another in every standards document. Such learners can achieve the following:

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 (© Copyright 2010. National Governors Association Center for Best Practices and Council of Chief State School Officers. All rights reserved.).

How This Book Works

As authors, we assume you have read *Visible Learning for Mathematics* (Hattie et al., 2017), so we are not going to recount all of the information contained in that book. Rather, we are going to dive deeper into aspects of mathematics instruction in grades K–2 that are critical for students' success, helping you to envision what a Visible Learning mathematics classroom like yours looks like. In each chapter, we profile three teachers who have worked to make mathematics learning visible for their students and have influenced learning in significant ways. Each chapter will do the following:

1. Provide effect sizes for specific influences, strategies, actions, and approaches to teaching and learning.
2. Provide support for specific strategies and approaches to teaching mathematics.

3. Incorporate content-specific examples from kindergarten, first grade, and second grade mathematics curricula.
4. Highlight aspects of assessment-capable visible learners.

Through the eyes of kindergarten, first grade, and second grade mathematics teachers, as well as the additional teachers and the instructional leaders in the accompanying videos, we aim to show you the mix and match of strategies you can use to orchestrate your lessons in order to help your students build their conceptual understanding, procedural fluency, and application of concepts and thinking skills in the most visible ways possible—visible to you and to them. If you're a mathematics specialist, mathematics coordinator, or methods instructor, you may be interested in exploring the vertical progression of these content areas across grades K–12 within Visible Learning classrooms and see how visible learners grow and progress across time and content areas. Although you may identify with one of the teachers from a content perspective, we encourage you to read all of the vignettes to get a full sense of the variety of choices you can make in your instruction, based on your instructional goals.

In Chapter 1, we focus on the aspects of mathematics instruction that must be included in each lesson. We explore the components of effective mathematics instruction (conceptual, procedural, and application) and note that there is a need to recognize that student learning has to occur at the surface, deep, and transfer levels within each of these components. Surface, deep, and transfer learning served as the organizing feature of *Visible Learning for Mathematics*, and we will briefly review them and their value in learning. This book focuses on the ways in which teachers can develop students' surface, deep, and transfer learning, specifically by supporting students' conceptual understanding, procedural knowledge, and application whether with equality or number combinations. Finally, Chapter 1 contains information about the use of checks for understanding to monitor student learning. Generating evidence of learning is important for both teachers and students in determining the impact of the learning experiences and challenging mathematical tasks on learning. If learning is not happening, then we must make adjustments.

Following this introductory chapter, we turn our attention, separately, to each component of mathematics teaching and learning. However, we will walk through the process, starting with the application of concepts and thinking skills, then direct our attention to conceptual understanding, and finally, procedural knowledge. This seemingly unconventional approach will allow us to start by making the ultimate goal or endgame visible: learners applying mathematics concepts and thinking skills to other situations or contexts.

Chapter 2 focuses on *application* of concepts and thinking skills. Returning to our three profiled classrooms, we will look at how we plan, develop, and implement challenging mathematical tasks that scaffold student thinking as they apply their learning to new contexts or situations. Teaching mathematics in the Visible Learning classroom means supporting learners as they use mathematics in a variety of situations. In order for learners to effectively apply mathematical concepts and thinking skills to different situations, they must have strong conceptual understanding and procedural knowledge. Returning to Figure I.4, we will walk through the process for establishing clear learning intentions, defining evidence of learning, and developing challenging tasks that, as you have already come to expect, encourage learners to see themselves as their own teachers. Each chapter will discuss how to differentiate mathematical tasks by adjusting their difficulty and/or complexity, working to meet the needs of all learners in the mathematics classroom.

Chapters 3 and 4 take a similar approach with conceptual understanding and procedural knowledge, respectively. Using Chapter 2 as a reference point, we will return to the three profiled classrooms and explore the conceptual understanding and procedural knowledge that provided the foundation for their learners applying ideas to different mathematical situations. For example, what influences, strategies, actions, and approaches support a learner's conceptual understanding of unknown values, part-part-whole relationship, and inverse operations? With conceptual understanding, what works best as we encourage learners to see mathematics as more than a set of mnemonics and procedures? Supporting students' thinking as they focus on underlying conceptual principles and properties, rather than relying on memory cues like "the alligator eats the larger number," also necessitates adjusting the

difficulty and complexity of mathematics tasks. As in Chapter 2, we will talk about differentiating tasks by adjusting the difficulty and complexity of these tasks.

In this book, we do not want to discourage the value of procedural knowledge. Although mathematics is more than procedural knowledge, developing skills in basic procedures is needed for later work in each area of mathematics from solving algebraic equations to evaluating functions. As in the previous two chapters, Chapter 4 will look at what works best when supporting students' fluency in procedural knowledge. Adjusting the difficulty and complexity of tasks will once again help us meet the needs of all learners.

In the final chapter of this book, we focus on how to make mathematics learning visible through evaluation. Teachers must have clear knowledge of their impact so that they can adjust the learning environment. Learners must have clear knowledge about their own learning so that they can be active in the learning process, plan the next steps, and understand what is behind the assessment. What does evaluation look like so that teachers can use it to plan instruction and to determine the impact that they have on learning? As part of Chapter 5, we highlight the value of feedback and explore the ways in which teachers can provide effective feedback to students that is growth producing. Furthermore, we will highlight how learners can engage in self-regulation feedback and provide feedback to their peers.

This book contains information on critical aspects of mathematics instruction in grades K–2 that have evidence for their ability to influence student learning. We're not suggesting that these be implemented in isolation, but rather that they be combined into a series of linked learning experiences that result in students engaging in mathematics learning more fully and deliberately than they did before. Whether translating a pattern or solving a mental math problem, we strive to create a mathematics classroom where we *see* learning through the eyes of our students and students *see* themselves as their own mathematics teachers. As learners progress from combining quantities to solving for unknown addends, teaching mathematics in the Visible Learning classroom should build and support assessment-capable visible mathematics learners.

Please allow us to introduce you to Adrien Paulson, Adam Southall, Calder McLellan, and Carol Busching. These four elementary school teachers set out each day to deliberately, intentionally, and purposefully impact the mathematics learning of their students. Whether they teach kindergarten, first grade, or second grade, they recognize that:

- They have the capacity to select and implement various teaching and learning strategies that enhance their students' learning in mathematics.
- The decisions they make about their teaching have an impact on student learning.
- Each student can learn mathematics, and they need to take responsibility to teach all learners.
- They must continuously question and monitor the impact of their teaching on student learning. (Adapted from Hattie & Zierer, 2018)

Through the videos accompanying this book, you will meet additional elementary teachers and the instructional leaders who support them in their teaching. Collectively, the recognitions above—or their **mindframes**—lead to action in their mathematics classrooms and their actions lead to outcomes in student learning. This is where we begin our journey through *Teaching Mathematics in the Visible Learning Classroom*.

Mindframes are ways of thinking about teaching and learning. Teachers who possess certain ways of thinking have major impacts on student learning.