CORWIN Visible Learning[plus]®

How to Make MATHEMATICS LEARNING VISIBLE IN THE CLASSROOM

Top tips from thought leaders and experts

eBook

introduction

How do you to teach mathematics so each learner's needs are met? And how do you ensure learning is visible and able to be applied beyond the classroom?

The best kind of learning is the kind where students can connect and engage with the world around them long after they've left the classroom. But how do you know that learning actually occurred? They might be able to perform well—or even great—on assessments, but that doesn't mean that students are able to transfer the problem solving and strategic thinking skills they're developing to new contexts. Influencing your students' thinking and understanding as well as their learning really boils down to knowing if the tactics you're using are having the desired impact.

As the ideas behind the Visible Learning™ research states, most strategies that a teacher tries in the classroom are going to have some kind of impact—usually positive—on student learning; but if that's the case, why not work on those factors with the strongest effect?

The key to developing skills such as problem solving, abstract thinking, making sense of structure, evaluation, and creativity is first making sure that students know how to become their own teachers. Taking key themes from the Visible Learning research and applying them to the mathematics classroom is essential for creating an environment where learner's needs are met, mathematics learning is visible to the students and teachers alike, and knowledge can be applied outside the classroom.

Read on for top tips, strategies, and approaches from influential thought leaders for creating visibility of learning in the mathematics classroom.

Making Mathematics Learning Visible

By Douglas Fisher and Nancy Frey

Most people think of us as literacy educators instead of mathematics educators. Our professional lives have been shaped by the role that language plays in learning. We believe that human beings learn through language—listening, speaking, reading, writing, and viewing. And this applies to all content areas.

Despite our literacy backgrounds, we probably would not have written Visible Learning for Mathematics without our collaborators. It was Will Mellman who pushed us to write the book. Will was a math and science supervisor (and now a principal) and he wanted to know what works best in mathematics education. Who doesn't, right? We all know that mathematics knowledge is a gatekeeper. Students who don't master mathematical concepts are less likely to graduate from college. And mathematics is a central part of so many careers—not just accounting!

Naturally, Will's quest for what works led us to John Hattie's seminal work.

As many of you may well know, John's Visible Learning research is a meta-meta-analysis of thousands of studies involving millions of students. It's been called the "holy grail" of educational research and we believed that this would allow us to figure out what works best and when, specifically regarding mathematics.

Together with well-known mathematics education experts Linda Gojak and Sara Delano Moore, we embarked on this endeavor. We began working to draw connections between John's research and what mathematics education-specific research tells us works, and then situating it all squarely in the mathematics classroom through stories and examples, so that we could help teachers really see and feel why the Visible Learning approach makes sense for math.

Surface, Deep, and Transfer

One of the key concepts in this book and in the professional learning offerings is about the level of learning students need to do. We have organized information about surface levels of learning and compare that with deep learning and transfer of learning.

Importantly, surface does not mean superficial. Unfortunately, a lot of people don't value surface level learning, which we see as a big mistake. At the surface level, students meet concepts and ideas. Over time, they use those concepts and apply what they have learned. But what's even more important is that the instructional strategies that teachers use to develop students' surface level understandings don't work very well at the deep or transfer levels. And what works at the deep level doesn't really work well for surface level learning.

We've come to learn that matching the right approach (be that instructional strategy or classroom experience) for the right type of learning is what makes the difference when it comes to impact on students' learning.

Direct Instruction vs. Dialogue

As we wrote this book with our amazing collaborators, we were continually confronted with the question about direct versus dialogic approaches to mathematics instruction. We consulted a number of professional resources as well as John Hattie's Visible Learning research. In the end, we agreed that **there is a need for both**.

We believe that timing is important, not to mention the sequence of lessons. When teachers know who their students are, what they need to learn, and what they have already mastered, they can identify specific instructional moves that will close the gap. Sometimes, that means that the teacher uses a more direct approach. Other times, it means that students need to engage with others.

To our thinking, it's about being *strategic* rather than adhering to one philosophy over another.

What's more interesting, at least to us, is the use of rich mathematical tasks that require students to mobilize their understandings and their resources and bring all that they have to bear on the situation. These rich mathematical tasks require that students collaborate with their peers and that they draw on past experiences and previous instruction. Mathematics classes should be filled with language – the language of learning.

Then teachers can determine what students know and use that information to determine the impact that they have had on learning. This will take us full circle, as teachers who know the impact that have on students' learning allows them to identify future learning experiences to further close the gap. When this happens, proficiency in mathematics is heightened and students are able to apply their knowledge in a wide range of situations.

We feel so lucky to have been part of the translation of John Hattie's Visible Learning research into guidance that math teachers can use to validate and extend their instructional repertoires. Read *Visible Learning for Mathematics*, and talk to a Senior Professional Learning Advisor about *Visible Learning for Mathematics professional learning*, and discover these strategies for yourself.

Building Assessment-Capable Visible Learners in Mathematics

By: John Almarode

The story behind the [1,600 meta-analyses comprising more than 95,000 studies involving 300 million students] represented in the Visible Learning research is this: *learning best occurs when teachers see the learning through the eyes of their students and students see themselves as their own teachers*. In mathematics, when learners see themselves as their own teachers, becoming Assessment-Capable Visible Mathematics Learners, they embrace certain dispositions, engage in specific learning processes, and assimilate feedback in the learning of mathematics content and processes. *Teaching mathematics in the Visible Learning Classroom* aims to build and support assessment-capable visible learners (Frey, Hattie, & Fisher, 2018). This more than triples the rate of learning in one school year (Effect Size = 1.33).

So, what is an assessment-capable visible learner in mathematics?

The following characteristics are common in assessment-capable visible mathematics learners:

1. **They are 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: "I am comfortable finding the simultaneous solution for a system of equations using graphing, but need more learning on the elimination and substitution approach. I know there are examples in my interactive notebook that I can use to prepare for tomorrow's challenge problem."

2. **They are able to plan the next steps in their progression toward mastery in learning mathematics content.**

   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 metacognitive strategies) to support working toward given learning intentions and success criteria in mathematics. For example, a student might respond to feedback, saying, "There is a more efficient way to solve this quadratic equation. I am going to use completing the square this time to see if I can find a more precise answer."

   They know what additional tools they need to successfully move forward in a task or topic: "To find the solution to the system of equations, I am going to use substitution. Looking at the graph of this system of equations, the solutions does not appear to be a pair of integers. Substitution will allow me to find a more accurate and precise solution."

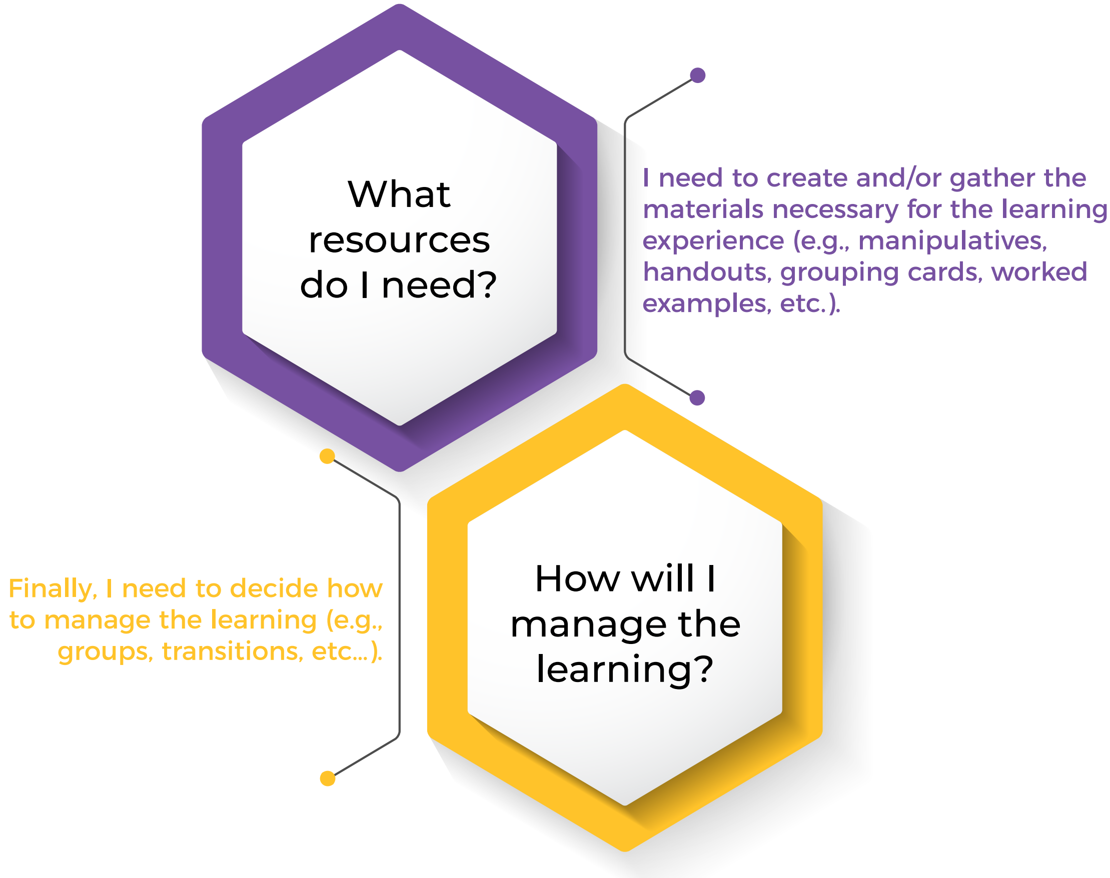
3. **They are aware of the purpose of the assessment and feedback provided by peers and the teacher.**

   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. "Yesterday's exit ticket surprised me. Ms. Norris wrote on my paper that I needed to revisit the process for isolating x and then substituting the expression into the second equation. So, today, I am going to work out the entire process in my notebook and not try to skip steps or do parts of the process in my head." Put differently, these learners not only seek feedback, but they recognize that errors are opportunities for learning, they monitor their progress, and adjust their learning (adapted from Frey et al., 2018).

   With an effect size of 1.33, planning and implementing a mathematics learning environment that allows learners to see themselves as their own teacher is essential in today's classrooms. In Visible Learning schools and classrooms, teachers work deliberately, intentionally, and purposeful with their learners to monitor their learning progress in mathematics.

How do we build assessment-capable visible learners in mathematics?

Rather than checking influences with high-effect sizes off the list and scratching out influences with low-effect sizes in our mathematics classrooms, we should match the best strategy, action, or approach with the learning needs of our math learners. As we emphasize in the upcoming grade-level series, using the right approach at the right time increases our impact on student learning in the mathematics classroom (Almarode, Fisher, Assof, Hattie, & Frey, in press; Almarode, Fisher, Assof, Moore, Hattie, & Frey, in press). For both teachers and students, Visible Learning in the mathematics classroom is a continual evaluation of impact on learning. Let's look at a specific, and often controversial example in the mathematics department workroom: the use of calculators.



Should I allow my students to use calculators?

The use of calculators is not really the issue and should not be our primary focus. Using calculators has a relatively small effect size of 0.27. Instead, our focus should be on the intended learning outcomes for that day and how calculators support that learning. In other words, **is the use of calculators the right strategy or approach for the learners at the right time for this specific content?**

This requires that both teachers and students have clarity about the learning intention – what the learning should be 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. This requires us, as mathematics teachers, to be clear in our planning and preparation for each learning experience and challenging mathematics tasks. Using guiding questions, we can best blend what works best with what works best *when*.

So, it turns that the question, "Should I allow my learners to use calculators?" is the wrong question.

Our focus as teachers should be 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 processes as well as mathematics content. 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.

If you're interested in learning more about making assessment-capable visible mathematics learners, read *Teaching Mathematics in the Visible Learning Classroom Grade-Level Series*, or talk to a Senior Professional Learning Advisor about [Visible Learning for Mathematics professional learning](#).

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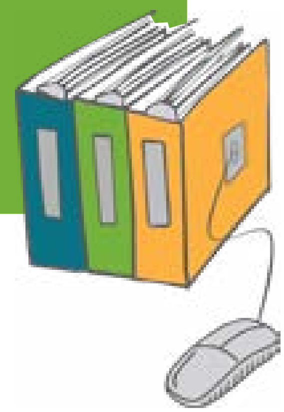


References

i. Almarode, J., Fisher, D., Assof, J., Moore, S. D., Hattie, J., & Frey, N. (in press). Teaching mathematics in the visible learning classroom, grades 6 – 8. Thousand Oaks, CA: Corwin Press.

ii. Almarode, J., Fisher, D., Assof, J., Hattie, J., & Frey, N. (in press). Teaching mathematics in the visible learning classroom, high school. Thousand Oaks, CA: Corwin Press.

iii. Frey, N., Hattie, J., & Fisher, D. (2018). Developing assessment-capable visible learners. Thousand Oaks, CA: Corwin Press.

iv. Hattie, J. (2012). Visible learning for teachers: Maximizing impact on learning. New York, NY: Routledge.

Creating Clarity in the Early Childhood Mathematics Classroom

By: John Almarode and Kateri Thunder

When learners can articulate what they are learning, why they are learning it, and how they know they will be successful, they possess clarity about their learning (see, Almarode & Vandas, 2018; Fisher, Frey, Amador, & Assof, 2018). Clarity in teaching and learning makes a significant impact on the learning growth for students in any classroom and also serves as a foundation for further learning. Based on Hattie's Visible Learning research (2009, 2012) and his quantification of the influences on learning, an effect size of 0.40 equates to one year's learning growth in one year's time. With an average effect size of 0.75, teacher clarity results in almost twice the average effect size of one year of formal schooling. What better place to have this high impact on our learners than the early childhood mathematics classroom.

What is clarity?

Hattie (2009) describes clarity as communicating the learning intentions and success criteria so that students can identify where they are going, how they are progressing, and where they will go next, thus providing students enough clarity to own their own learning. A learning intention describes what it is that we want our students to learn (effect size = 0.68). Success criteria specify the necessary evidence students will produce to show their progress toward the learning intention (effect size = 1.13).

But how do we effectively communicate clarity to our youngest learners when they cannot yet read and when they are working on a complex network of learning outcomes (e.g., social-emotional, psychomotor, behavioral, etc.)? This can be navigated by adapting the way teachers communicate clarity:

1. Use visuals alongside academic vocabulary in the context of learning. Have students articulate what they are learning and connect multiple representations with academic vocabulary.
2. Demonstrate the high-order thinking skills and processes by modeling (i.e., thinking aloud) the connections between what they are learning and why.
3. Explicitly teach meta-cognitive skills through questioning so that learners are guided to think about their own learning.
4. Finally, provide visual rubrics, checklists, exemplars, and models to support learners as they begin to monitor their learning progress and know what success looks like.

What does this look like?

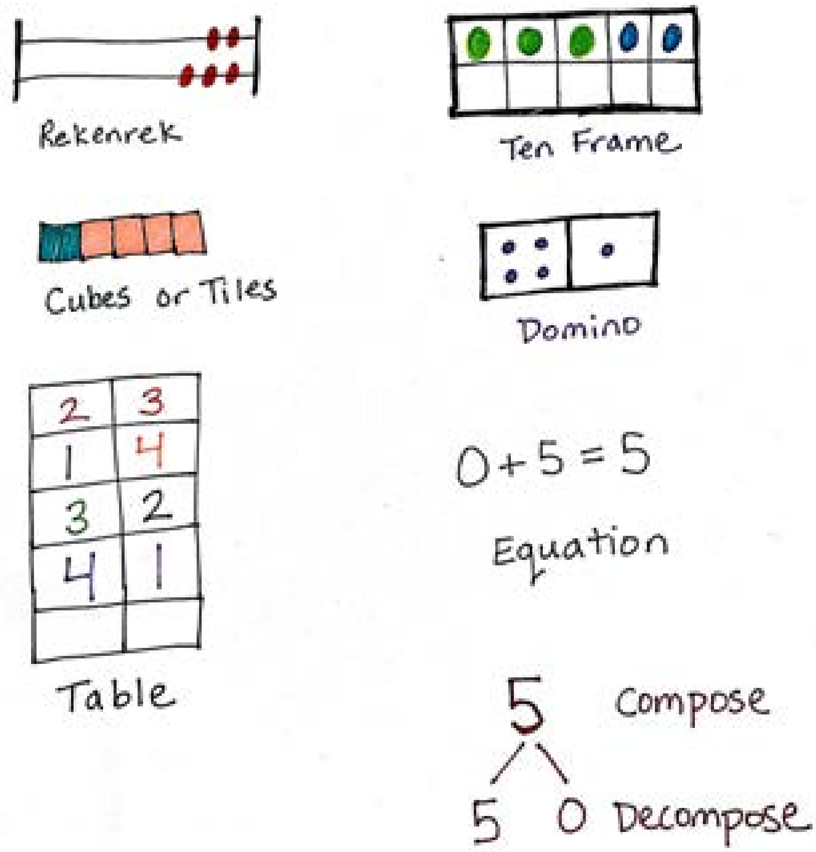
In Alisha Demchak's kindergarten class, students are learning to investigate and describe part-whole relationships for numbers up to 10 using multiple representations. As she introduces the learning intention and success criteria, Mrs. Demchak uses visuals alongside academic vocabulary, modelling of high-order thinking skills, questioning to teach meta-cognitive skills, and exemplars to support self-regulation.

Learning Intention: I am learning part-whole relationships with numbers.

Success Criteria:

1. I can identify the parts that make a number.
2. I can use the terms compose and decompose.
3. I can represent the parts of a number in different ways.

To support her young mathematicians, Mrs. Demchak provides visuals to accompany the success criterion:



Mrs. Demchak engages her students in high-order thinking to make sense of the learning intention and success criteria by facilitating their analysis of the anchor chart. "Looking at our work about the number 5, where do you see evidence that we can identify the parts that make a number?" (the first criterion). Students share their noticings of the ways 5 is broken into two parts on the rekenrek, ten-frame, cubes, domino, table, and equation. Students wonder if a number can be broken into more than two parts, posing their own mathematically rigorous and rich question.

Next, she thinks aloud to model ways to demonstrate the second criterion, "I remember from this example (pointing to the vocabulary terms and image) that compose means put together and decompose means break apart. In the table, we show a lot of ways to decompose 5 into two parts, like 2 and 3 or 1 and 4. On the ten-frame, we show both decomposing 5 into 3 and 2 and also composing by putting the 3 and 2 dots together to make one row of 5. We're wondering if 5 can be decomposed into more than two parts. What's another way you could describe our work using the terms compose and decompose?" Students practice using the academic vocabulary as they share their thinking.

Finally, Mrs. Demchak asks, "Were we successful representing parts of the number 5 in different ways? What evidence do you see?" (the third criterion). Students turn and talk with a partner to explain their thinking, pointing to the chart examples frequently. They extend the possibilities by sharing other manipulatives that could represent part-whole relationships. Mrs. Demchak's questions teach meta-cognitive skills while the anchor chart provides students with an example of what success looks like in order to support their self-monitoring.

Closing Remarks

Clarity about learning is not an opportunity to increase student learning only accessible to "older grade-levels." Instead, ensuring that we clearly organize instruction, explain content, provide examples and guided practice, and assess learning is paramount in our young learners. A key characteristic of a high-impact early childhood mathematics classroom is clarity that leads to learners taking ownership of their learning journey. What differs for our youngest learners is the way in which this clarity is communicated.

References

i. Almarode, J., & Vandas, K. (2018). Clarity for learning: Five essential practices that empower students and teachers. Thousand Oaks, CA: Corwin.

ii. Fendick, F. (1990). The correlation between teacher clarity of communication and student achievement gain: A meta-analysis. Unpublished doctoral dissertation, University of Florida, Gainesville.

iii. Fisher, D., Frey, N., Amador, O., & Assof, J. (2018). The teacher clarity playbook. Thousand Oaks, CA: Corwin.

iv. Hattie, J. A. (2009). Visible learning: A synthesis of over 800 meta-analyses relating to achievement. New York: Routledge.

v. Hattie, J. A. (2012). Visible learning for teachers: Maximizing impact on teachers. New York: Routledge.

conclusion

Put tools in students' toolboxes

Visible Learning for Mathematics professional learning is part of the Visible Learning[plus] Practice Series. The Practice Series is a collection of professional learning sessions that help teachers specifically put John Hattie's research into practice at the right time for maximum impact on their students' learning. During these sessions, teachers discover the strategies that build conceptual understanding of mathematical ideas and learn to design classroom experience that hit the surface, deep, and transfer phases of learning.

Not just another math program

The Practice Series is based on more than 25 years of research and many more years of experience of educators and thought leaders across the world. It's based on one simple belief: every student should experience at least on year's growth over the course of one school year. If you're not sure if or how you're going to help your students' growth, success, and achievement in mathematics, then it might be a great time to get in touch.

Dive deeper and discover more about our professional learning around Visible Learning for Mathematics, part of the Visible Learning[plus] Practice Series.

Discover more at **corwin.com/the-practice-series**