

# DMT INSIGHTS

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## DMTI AND HATTIE: CONNECTING RESEARCH TO MATHEMATICS INSTRUCTION

*What do these research findings look like in a mathematics classroom?*

### Introduction

John Hattie's Visible Learning work brought together a large body of research examining factors associated with student achievement (Hattie, 2008, 2012). Teacher clarity, feedback, metacognition, collective teacher efficacy, and other factors identified in this work have received considerable attention in schools (Donohoo et al., 2018; Hattie, 2017).

The more important question for mathematics educators is what these ideas look like in a mathematics classroom. Teacher clarity in mathematics is not simply posting a learning intention. Feedback is not simply telling a student whether an answer is correct. Metacognition is not simply asking students to reflect. Each becomes useful when it is connected to the mathematics students are learning and the thinking we want them to develop.

DMTI was not developed from Hattie's framework. Its practices grew from research on mathematical thinking, teaching, assessment, and professional development. However, important connections remain. This Insight examines those connections and, more importantly, what they look like when the mathematics stays at the center.

**Key Idea • DMTI and Visible Learning begin from different research. Where they connect, the useful question is what a finding looks like in the mathematics students are learning.**

### What an Effect Size Can and Cannot Tell Us

Visible Learning reports each factor as an effect size, a standardized measure of how large a difference is, and uses 0.40, the average across the factors, as a reference point (Hattie, 2008). The effect sizes reported in this Insight come from the 2017 update of the Visible Learning list, which draws on 1,400 meta-analyses (Hattie, 2017).

Effect sizes also need careful interpretation. An average effect across studies does not tell a teacher exactly what to do with a particular student, topic, or lesson. Researchers have cautioned against treating effect-size rankings as simple prescriptions because instructional effects depend on context, implementation, and what is being measured (Biesta, 2010; Snook et al., 2009).

For DMTI, the value is not in ranking strategies. It is in examining where findings from this broader research base intersect with what we know about teaching and learning mathematics.

**Key Idea • An effect size can point to a practice worth examining. It does not tell a teacher what that practice looks like in a particular mathematics lesson.**

## The DMTI Framework

The DMTI framework centers on five instructional practices:

1. Take students' ideas seriously.
2. Encourage multiple strategies and models.
3. Press students conceptually.
4. Focus on the structure of mathematics.
5. Use misconceptions to understand and reorganize student thinking.

These practices shape DMTI professional development, curricular resources, assessment, and classroom instruction. They are not five separate techniques. Together, they help teachers attend to what students understand, make mathematical relationships visible, and move student thinking toward increasingly formal mathematics.

**Key Idea • The five practices work together. Each one directs attention to what students understand and to the mathematical relationship they are developing.**

## DMTI Professional Development

DMTI professional development combines summer institutes with continued work during the school year. Teachers study mathematics, examine student thinking, work through models and representations, plan lessons, observe instruction, and receive feedback on their own practice.

Demonstration lessons are an important part of this work. Teachers observe students responding to mathematical tasks and questions in real classrooms, then analyze what students understood, where their reasoning changed, and what instructional decisions contributed to that change.

Coaching, classroom observations, and collaborative lesson and unit study extend this work beyond the initial professional development. The purpose is not simply to introduce instructional strategies. It is to help teachers see more mathematics in student thinking and make better instructional decisions from what they see.

Two studies have examined this professional development. In a cluster randomized trial, students in grades 2 to 5 in schools that received it achieved more in mathematics than students in control schools, and the effect held across grade levels (Brendefur et al., 2022). An earlier two-year study of six Title I schools reported gains in the three schools that received it (Brendefur et al., 2016).

**Key Idea • The purpose of the professional development is to help teachers see more mathematics in student thinking and make better instructional decisions from what they see.**

## Curricular Resources and Assessment

DMTI curricular resources put the same five practices into the daily work of teaching mathematics. Lessons are sequenced to build from students' existing ideas, make mathematical relationships visible through models and representations, and progressively formalize that reasoning.

DMTI's Math Learning Profiles (MLPs), formerly the Primary Mathematics Assessment (PMA) and the Intermediate Mathematics Assessment (IMA), add another part of the instructional cycle: identifying what a student understands before deciding what to teach next (Brendefur et al., 2015). Rather than relying only on a total score, the MLPs provide profiles across specific areas of mathematical reasoning that teachers can use to make instructional decisions.

**Key Idea • A profile across specific areas of mathematical reasoning tells a teacher more about what to teach next than a total score does.**

## Make the Mathematics Clear

*Hattie connection: Teacher clarity (effect size 0.75)*

Clarity in mathematics also means being clear about the mathematical idea students are developing. In multiplication, for example, students should understand the unit being iterated, how many times it is iterated, and how those iterations compose the total. A learning intention is useful when students and teachers can identify the mathematical relationship being developed and the evidence that shows students understand it.

In the Grade 3 multiplication unit, one learning intention is: "We will understand multiplication as iterations (copies) of a unit and represent it with bar models, ratio tables, and equations." One success criterion is: "I can represent multiplication using bar models, ratio tables, and equations and explain how it represents iterations of a unit." A student who meets the criterion can show the unit, the number of iterations, and the total in each representation.

**Key Idea • Clarity in mathematics means being clear about the relationship students are developing and the evidence that would show they understand it.**

## Use Feedback to Press Student Thinking

*Hattie connection: Feedback (effect size 0.70)*

DMTI feedback often takes the form of a question rather than a correction. When a student places  $\frac{1}{4}$  on a number line, the teacher might ask: "What does the 1 count? What does the 4 tell us about the unit?" The purpose is to make the student's reasoning visible and determine the next question. This is the DMTI practice of pressing students conceptually.

**Key Idea • Feedback should move the mathematics forward, not simply evaluate the answer.**

## Ask Students to Explain and Compare Their Reasoning

*Hattie connection: Metacognitive strategies (effect size 0.60)*

Students should explain a strategy, represent it, connect it to another representation, compare it with another method, and determine when it would be useful. After comparing two fractions, for example, a student might be asked: “What strategy did you use? Where does your number line show the same comparison? When would a different strategy be more useful?” A second strategy matters when students can identify the mathematical relationship the two strategies share.

**Key Idea • The goal is not reflection for its own sake. Students learn to examine the mathematical relationships within their own strategies.**

## Start With the Ideas Students Already Have

*Hattie connection: Piagetian programs (effect size 1.28)*

Taking students’ ideas seriously means beginning with what students already understand. In the Kindergarten unit Counting and Number Sense, children count collections of objects, represent the quantities with counters and drawings, and connect those representations to numerals. Students benefit from acting on quantities, representing relationships, and connecting those representations to notation. The goal is not to move away from models as quickly as possible. It is to preserve the mathematical relationship as representations become more formal.

Hattie’s synthesis includes a factor called Piagetian programs, which concerns how students’ level of reasoning relates to achievement (Hattie, 2008). The connection to DMTI is modest: instruction begins from the reasoning students bring, not from a required sequence from concrete to abstract.

**Key Idea • Begin with the reasoning students bring. Preserve the mathematical relationship as the representations become more formal.**

## Use Misconceptions to Reorganize Thinking

*Hattie connection: Conceptual change programs (effect size 0.99)*

A misconception is often a reasonable idea used in a context where it no longer fits. DMTI teachers first try to understand the conception behind the answer: Where does the student’s idea work? What changed in this situation? What relationship needs to be reorganized?

For example, students may develop the idea that multiplication makes quantities larger because that idea works across many early whole-number examples. Multiplication by a number less than one creates a boundary for that conception. In  $\frac{1}{2} \times 6$ , the iterator is less than one, and the total, 3, is smaller than the unit 6. The instructional goal is not simply to correct the answer. It is to help the student reorganize the idea. DMT Insight 5 examines misconceptions in more detail.

**Key Idea • A misconception is often a reasonable idea used where it no longer fits. The goal is to help the student reorganize the idea, not simply to correct the answer.**

## Give Students Something Mathematical to Reason About

*Hattie connection: Problem-solving teaching (effect size 0.68)*

A worthwhile problem gives students something mathematical to reason about before introducing a procedure. Models then make the relationships in that reasoning visible. As students compare strategies and representations, the teacher can help formalize the mathematics. For example, students partition a rectangular cake equally among 6 people, represent the partitioning with an area model, and name each share as one-sixth of the cake before a procedure for fractions is introduced.

**Key Idea • The procedure records the mathematics; it does not create it.**

## Use Assessment to Decide What Mathematics Comes Next

*Hattie connection: Response to intervention (effect size 1.29)*

Assessment should tell us more than whether a student is below a benchmark. It should help identify what the student understands and what mathematics should come next. DMTI's MLPs provide profiles across specific areas of mathematical reasoning, so intervention can match the mathematics a student needs. Targeted activities accompany each area for work with individuals or small groups.

**Key Idea • Match intervention to the mathematics a student needs, not only to a benchmark.**

## Develop Teachers Together

*Hattie connection: Collective teacher efficacy (effect size 1.57)*

Collective teacher efficacy is teachers' shared belief that together they can affect student learning (Donohoo et al., 2018). DMTI professional development is designed as collective work. Teachers study mathematics together, examine student thinking, plan and analyze lessons, observe demonstration lessons, and discuss evidence from their own classrooms. Coaching and classroom observations extend that work across the year.

The important connection to collective teacher efficacy is not simply that teachers collaborate. They develop shared ways of looking at mathematics, student thinking, and evidence of learning.

**Key Idea • Collective work builds shared ways of looking at mathematics and student thinking.**

## Conclusion

Hattie's work and DMTI begin from different places. Visible Learning synthesizes findings across a broad range of educational research. DMTI focuses specifically on how students learn mathematics and how teachers can respond to that thinking.

The value is in the points where the two bodies of work connect. Clarity matters, but clarity should be about the mathematics. Feedback matters, but it should help uncover and move student thinking. Metacognition matters when students explain, represent, connect, compare, and generalize mathematical relationships. Teacher collaboration

matters when teachers develop a shared understanding of the mathematics and of what student understanding looks like.

**Key Idea • No effect size tells a teacher what question to ask a particular student tomorrow. Research can tell us where to look. The mathematics and the student's thinking help determine what to do next.**

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## Social Media

What does feedback sound like when a student places one-fourth on a number line?

John Hattie's Visible Learning research names factors such as teacher clarity and feedback. Naming a factor does not tell a mathematics teacher what to do with it. Inside this DMT Insight, we look at:

- Where DMTI's independently developed framework connects with Visible Learning
- What teacher clarity means when students are developing multiplication as iterations of a unit
- How a question can serve as feedback that moves the mathematics forward
- Why a misconception is often a reasonable idea used where it no longer fits

Read the full Insight at [mathsuccess.io/dmtinsights](https://mathsuccess.io/dmtinsights).

When a student gives a correct answer this week, what question will you ask next?



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