NEWSLETTER

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WHEN TECHNOLOGY DOES THE THINKING FOR THEM

In today's edition, we explore:

- **The Classroom Reality:** Why students who appear successful on a screen still struggle the moment the supports come off — not because they lack practice, but because the supports performed the cognitive work for them
- **The Structural Why:** Why drawing, writing, and effortful retrieval build connected understanding that watching, clicking, and recognizing cannot
- **The Instructional Shift:** How to use technology without letting it do the mental work your students still need to do themselves — and what a workbook, pencil, and student-drawn model are really for

Educators

A student completes a digital math lesson with a perfect score. Twenty-four hours later, given the same problem on paper, she stares at it and says, "I don't remember how to start." She knows she did it yesterday. She does not know how.

Another student is asked to draw a bar model for ¾x + 5 = 17. He pauses. He has watched bar models on a screen, but he has not drawn one. He is not sure how big to make the bar or where the 5 goes. The drawing has never lived in his hand.

A third student answers "½ and 2/4 are equivalent" instantly on a recognition task — and gives up entirely when asked to explain why 50/100 is also equivalent. She has seen the pairing many times. However, she has never partitioned the bar, folded the strip, or drawn the number line. The recognition is fast; the understanding is missing.

These three students share something important: each appears successful in a digital environment, but none has built the connected understanding the screen seemed to demonstrate. The supports performed the cognitive work, and the work they did was not the work students still needed to do. **When a tool does the thinking for the student, the student does not learn to think.**

Our latest **DMT Insight — Mathematical Thinking in the Age of Digital Dependence** — explains how cognitive

outsourcing reshapes what students learn, why drawing and handwriting matter for the developing brain, and what changes when teachers reclaim the cognitive work as the work.

The Classroom Reality: When the Tool Does the Thinking

In many classrooms, digital tools have quietly taken over the cognitive work students used to do themselves:

- Adaptive software guides students step by step through a procedure, so they never have to decide which step comes next — they only have to follow the one the screen has chosen for them
- AI assistants generate explanations and worked examples on demand, so students learn to read solutions rather than construct them
- Recognition-based tasks — multiple choice, drag and drop, fill in the blank from a menu — let students pick correct answers without ever retrieving or organizing the underlying ideas
- Drawings and models are animated on screen rather than constructed by the student, so the act of deciding scale, partitioning space, and coordinating quantities never happens

From the student's perspective, the message is consistent: the screen will help you finish. From the teacher's perspective, the data look good. From a cognitive science perspective, very little durable learning is happening.

So students develop the logic their environment has taught them:

- "If I get stuck, the hint button will get me through it."
- "I don't need to draw it — the app draws it for me."
- "If I can recognize the answer, I understand the math."

The performance is consistent — even when the understanding is not.

The Structural Why: Why Drawing and Retrieval Matter

Research from cognitive psychology, neuroscience, and mathematics education helps explain what changes when students do the cognitive work themselves rather than handing it off to a tool.

Drawing reduces cognitive load and builds structure. Math models — bar models, number lines, area models — externalize relationships so students can examine them rather than hold them in working memory (Sweller, 1988). When students physically construct these models, they make decisions about scale, partitioning, and labeling that the digital tool would otherwise make for them. Those decisions are the learning.

Handwriting engages systems that typing and clicking do not. Research on physically constructing representations suggests that the motor act of writing activates broader neural systems involving language, motor processing, spatial reasoning, attention, and memory encoding (Horvath, 2024). When students are young, this matters even more — the act of drawing a bar model or writing a definition by hand helps build the very mental architecture that will hold

that idea later.

Retrieval beats recognition. Students do not build understanding by repeatedly seeing information. They build it by repeatedly *retrieving* it — reconstructing a model, writing an equation, explaining a relationship without immediate scaffolding (Roediger & Karpicke, 2006). Recognition tasks feel like learning. They are not.

Connected understanding transfers; isolated procedures do not. Cognitive psychologists describe the goal as *relational understanding* — the ability to see how ideas connect rather than treating each procedure as an isolated rule (Hiebert & Carpenter, 1992; Skemp, 1976). Students who recognize that ½ = 2/4 = 3/6 share an underlying multiplicative structure can transfer that reasoning to new fractions. Students who memorize each pair separately have to start over each time.

The result, when students do the cognitive work themselves, is that they don't just produce answers. They build understanding that holds across the week, across the unit, across the year.

The Instructional Shift: Reclaim the Cognitive Work

The DMT Insight proposes a foundational reframe: technology is not the enemy. Cognitive outsourcing is. The instructional shift is not anti-tech — it is pro-thinking. This requires deliberate moves in your classroom:

- **Draw before clicking.** Every problem begins with the question, "What does the model look like?" Students draw the bar, the number line, or the diagram by hand before any digital tool is introduced. The drawing is not a step before the math — it is the math.
- **Choose tools that ask, not tools that answer.** Adaptive practice that requires active recall and student-constructed responses is different from step-by-step scaffolding that bypasses cognitive effort. The question is not whether a tool is digital. It is what the tool asks the student to do.
- **Hide the hint button — at least sometimes.** Once a week, give students problems without immediate scaffolds. Let them struggle for a few minutes. The struggle is where the learning lives. (I've watched a sixth grader erase a bar model four times because the scale was wrong — and that struggle taught more than any hint button ever could.)
- **Workbooks that demand thinking, not workbooks that demand boxes.** A workbook that only asks for final answers in blank boxes is not the same as one that requires students to draw, label, and explain. Use pages that ask students to construct models, compare strategies, and write reasoning — not pages that reduce mathematics to fill-in-the-blank recognition.

When teachers ask, at every grade level and across every tool, "What is the cognitive work this problem is asking the student to do — and is the student actually doing it?" — the relationship between technology and learning starts to repair itself.

Small questions create large shifts:

- "Draw the model first. Then we'll talk about the operation."

- “Explain to me what you would do if you didn’t have the app right now.”
- “Before I help, show me what you’ve drawn. Where is the unknown?”

These questions move students from *performing* mathematics on a screen to *thinking* about mathematics on paper.

Your Turn to Share

We would love to hear from you. **What is one moment when a student’s pencil-and-paper work showed you something about their thinking that a digital score never could have?**

Share your thoughts at **contact@dmtinstitute.com**. We will compile and elevate your insights to help advocate for stronger teacher support across districts.

Keep inspiring mathematical minds!

MORE INFORMATION

This newsletter is just a preview—there is much more to explore. For the complete **research overview**, visit the **DMT Insights** page at **dmtinstitute.com/research**.


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