

SCIENCE OF LEARNING 101

DITCHING THE TRENDS FOR WHAT ACTUALLY WORKS IN THE CLASSROOM

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Former Principal and 5th - 12th Teacher

About **Me**

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Reclaiming Your Practice

Why explicit, teacher-led instruction isn't old-fashioned—it is
biologically sound.



| The Direct Teaching Edge

Deconstructing the "Guide" Myth

For decades, teacher preparation programs pushed the narrative to be a "guide on the side," accusing direct instruction of causing dry, passive learning.

Direct, structured, teacher-led instruction is the most efficient, protective, and compassionate way to hand knowledge over to a child.

The data has caught up. The Science of Learning validates exactly what veteran teachers were doing before unguided discovery took over the classroom.



Science of Learning History

How did we end up here?

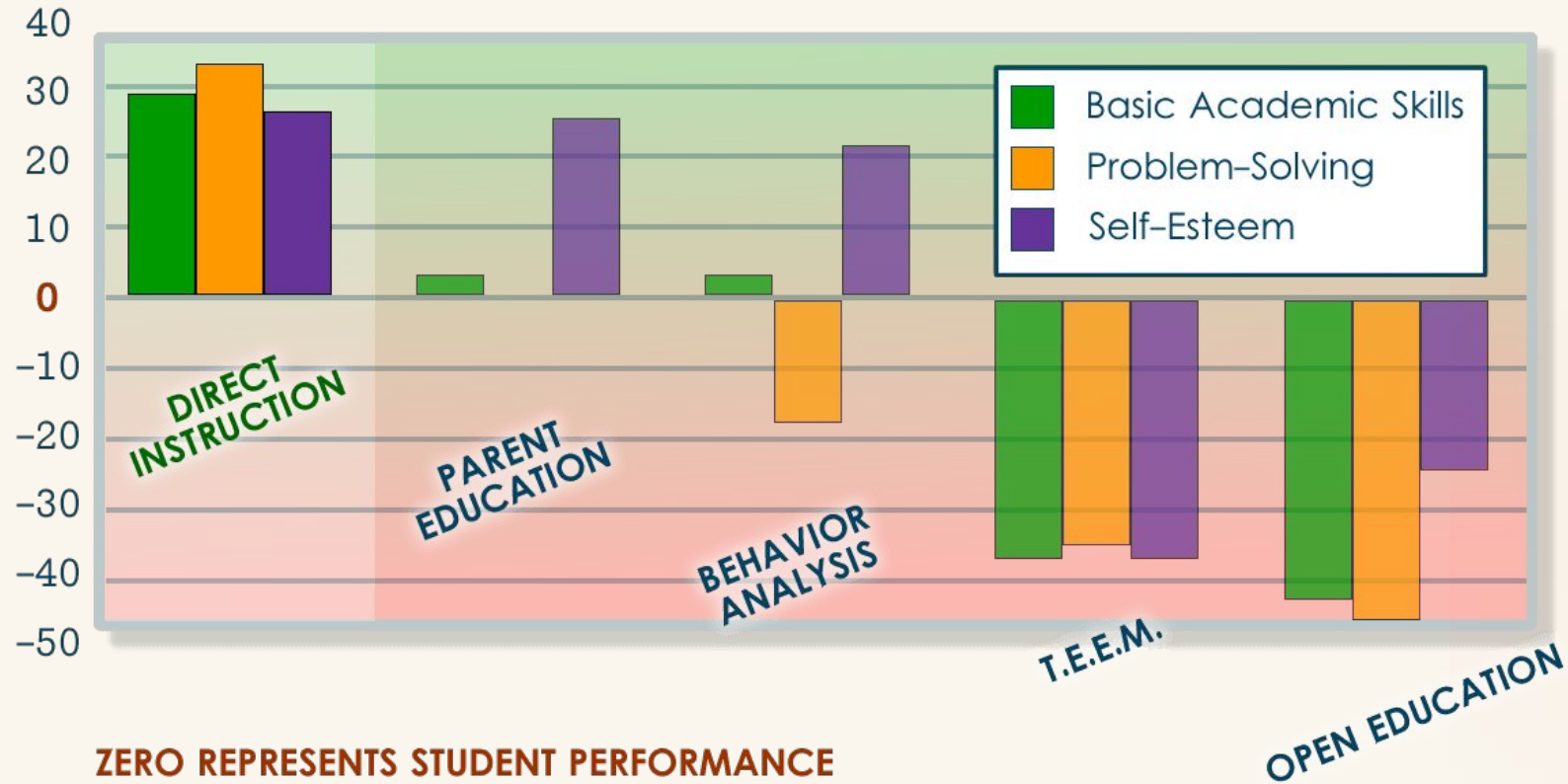


Project Follow Through and the Search for Success

- Launched in 1968 under the U.S. federal government, Project Follow Through stands as the **largest and most expensive experimental research project in educational history** (National Institute for Direct Instruction).
- The massive study spanned from 1968 to 1977, evaluating over **200,000 children** across 178 communities to discover the most effective instructional methods for early elementary grades (National Institute for Direct Instruction).
- The experiment rigorously compared **22 distinct educational models**, categorizing them into basic skills, cognitive–conceptual skills, and affective–humanistic skills (National Institute for Direct Instruction).
- **The Major Players:** The Direct Instruction (DI) model, developed by Siegfried Engelmann and Wesley Becker at the University of Oregon, stood trial against standard progressive, child–centered discovery models (Siegfried Engelmann / University of Oregon).



PROJECT FOLLOW THROUGH



ZERO REPRESENTS STUDENT PERFORMANCE IN TRADITIONAL SCHOOLS.



| Mapping the Architecture of Human Memory

- While K-12 schools systematically ignored Project Follow Through, cognitive psychologists spent the 1980s and 1990s mapping how human brains actually process and store information in laboratory settings.
- **The Major Player (John Sweller, 1988):** Educational psychologist John Sweller formulated Cognitive Load Theory, defining the strict limits of human working memory and the mechanics of long-term memory schema building.
- **The Major Player (Richard Mayer, 1990s):** Throughout the 1990s, Richard Mayer established the Cognitive Theory of Multimedia Learning, proving that split-attention visual effects and electronic clutter systematically degrade long-term comprehension.
- For nearly thirty years, this vital data remained trapped in academic journals and ivory towers, completely isolated from real-world K-12 teacher training programs and curriculum design.

| Mapping the Architecture of Human Memory

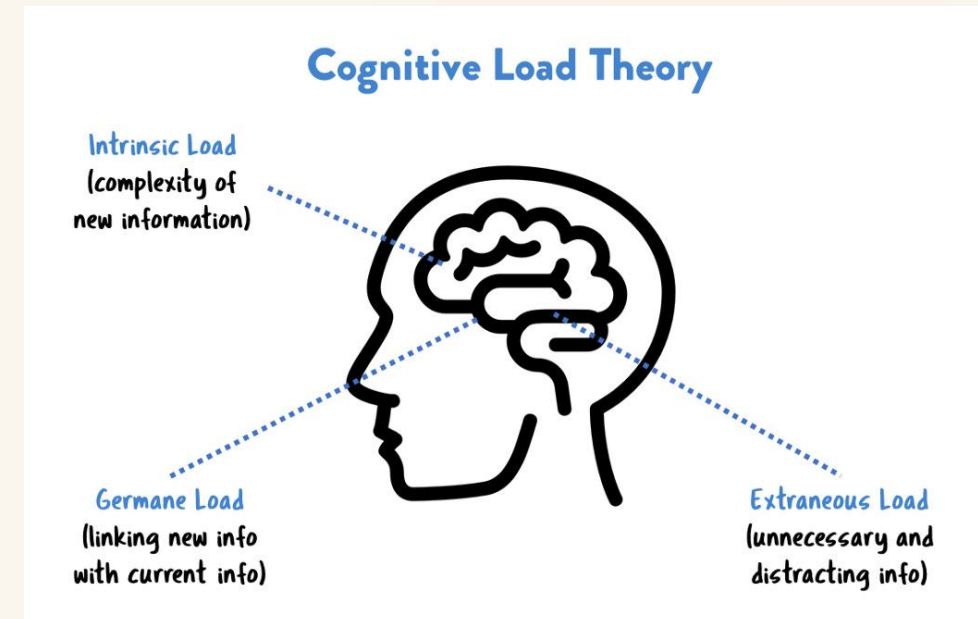
- **The Catalyst (John Hattie, 2008):** Educational researcher John Hattie published *Visible Learning*, a massive meta-analysis synthesizing over 800 meta-analyses on achievement, proving empirically that explicit instruction and direct feedback yield the highest instructional effect sizes.
- **The Translator (Dan Willingham, 2009):** Cognitive scientist Dan Willingham published *Why Don't Students Like School?*, translating decades of complex brain science into highly practical laws for active classroom teachers.
- Dan Willingham established the baseline law that "**memory is the residue of thought,**" proving that students only remember what they actively think about, not what they merely see or read on screens.
- **The Cognitive Researchers (Karpicke & Roediger, 2008):** Breakthrough memory studies proved that repeated active testing (**retrieval practice**) permanently flattens the forgetting curve, completely outperforming passive re-studying or highlighting.

| The “Big Four”

Basics of SoL Learning Strategies

Research consistently shows that these four methods are the most effective for long-term retention.

- **Retrieval Practice:** Instead of re-reading notes, pull information *out* of your head.
 - *Examples:* Flashcards, practice tests, or writing down everything you remember on a blank sheet of paper.
- **Spaced Repetition:** Spread your study sessions out over time rather than "cramming." This exploits the Spacing Effect.
 - *The Rule:* Review information just as you are about to forget it.
- **Interleaving:** Mix up the topics or types of problems you practice in a single session.
 - *Example:* Instead of doing 10 addition problems then 10 subtraction problems, mix them together (A-S-A-S). This helps the brain learn to *discriminate* between concepts.
- **Dual Coding:** Combine words with visuals. The brain processes verbal and visual information through different channels, creating two "hooks" for the same memory.



The Cognitive Pipeline

How information moves through a unified human brain from
input to permanent ownership.

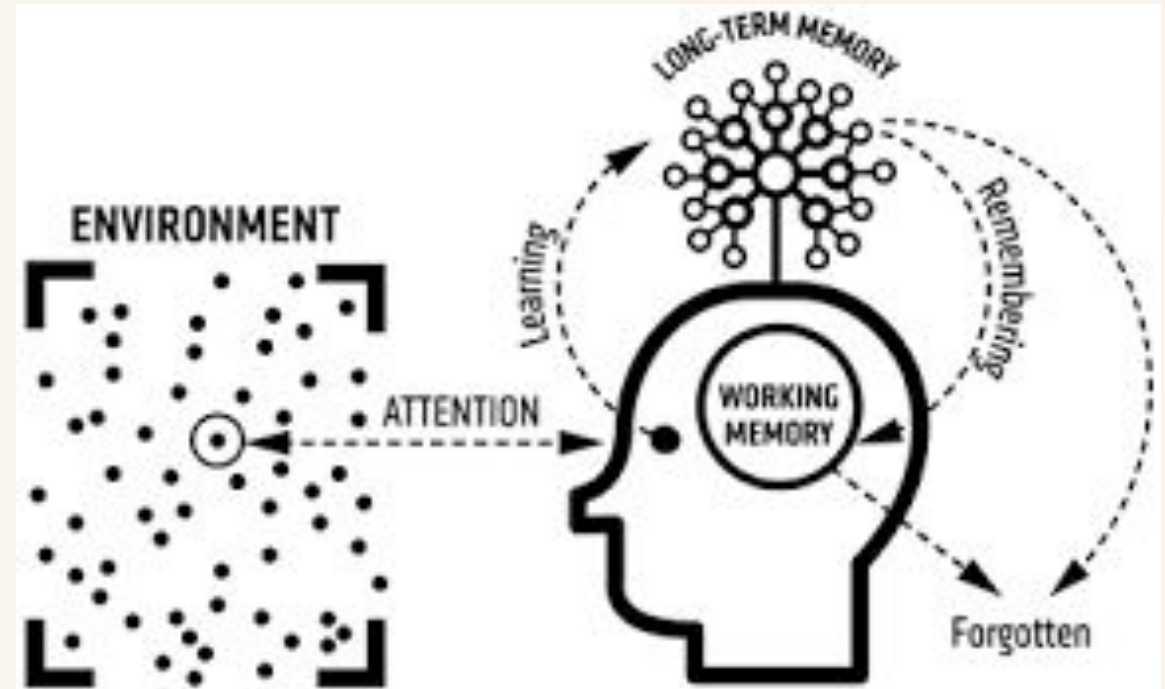


| How the Mind Processes Learning

The Information Processing Model

Before implementing classroom strategies, we must understand the hardware we are teaching:

- **Sensory Filter:** Filters environmental inputs. Only focused attention passes information to the next stage.
- **Working Memory:** Highly limited workbench (5-7 chunks). Overloading it blocks connection-making/learning.
- **Long-Term Memory:** Infinite warehouse. Requires active, repeated retrieval to stay accessible.



The Interconnected Mind - Attention is KEY



1. Attention

The Gatekeeper: If student focus is split by classroom noise or high-tech visual clutter, information never enters the mind. The process stops before it begins.



2. Connection

The Workbench: Once inside, data sits on a fragile mental workbench (**working memory**). If we overload it with unguided inquiry or complex rules, it breaks.



3. Retrieval

The Warehouse: Storing data in **long-term memory** requires building paths back to the boxes. Actively pulling the knowledge out prevents neural pathways from rotting.

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| The Working Memory Bottleneck



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- **The Cognitive Bottleneck:** Educational psychologist John Sweller's Cognitive Load Theory proves that human working memory is a strict bottleneck with a highly limited capacity.
- **The 4-to-7 Rule:** The working memory can only hold between 4 and 7 pieces of information at any given time before it experiences information overload.
- **The Digital Flood:** When teachers use complex digital interfaces, multi-step online dashboards, or fast-paced video animations, they completely flood this limited mental workspace.



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- **Elaboration:** Linking new concepts to personal experiences or prior knowledge.
- **Chunking:** Breaking down information into smaller, manageable units.
- **Dual Coding:** Combining verbal information with visual aids.
- **Contextual Learning:** Creating sensory-rich, realistic scenarios (e.g., simulations) to make memories more vivid.

DON'T OVERTHINK THIS!!!

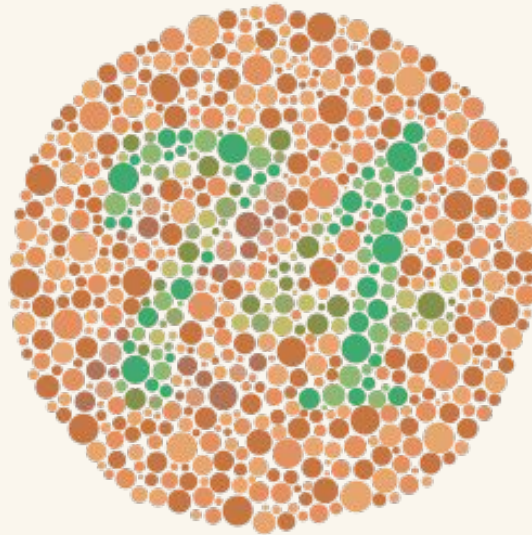


| The Architecture of Micro-Segmentation

- **Deconstruct the Standard:** Reject large, vague instructional blocks. Micro-segmentation is the practice of isolating a complex skill and breaking it down into its absolute smallest, independent components.
- **The 2-5 Minute Input Cap:** Deliver an explicit explanation or teacher model for only a few minutes (age clearly dictates this). This tight boundary prevents the limited working memory workbench from overloading.
- **The Immediate Output Loop:** Immediately pause the lecture and force students to actively execute or retrieve just that single micro-step on paper or a response slate.
- **Verify Before Progressing:** Use a high-accountability check (like Cold Call or universal whiteboards) to audit 100% of the room. If the room handles the micro-step successfully, layer on the next piece; if they struggle, pause and fix it live.

Practice Time!!

A woman with normal sight has a father who is color blind. She marries a man with normal sight. What is the probability their first born son will be color blind?



Dual Coding in Practice

Visual + Verbal Integration

Cognitive science reveals that the human brain processes information through two separate, independent channels: a verbal channel and a non-verbal/visual channel.

When you present an idea using both pathways simultaneously—like explaining a grammar rule while pointing to a hand-drawn diagram—you build double memory traces.

"Students learn much more deeply from words and pictures together than from words alone. But simplicity is key to avoid overloading the visual registry."

— DR. RICHARD E. MAYER

The Dual Coding Framework

VERBAL



- Words
- Linguistic knowledge

VISUAL



- Images
- Perceptual knowledge

INTEGRATING



- ✓ Form connections
- ✓ Better understanding



Notes

Genetics

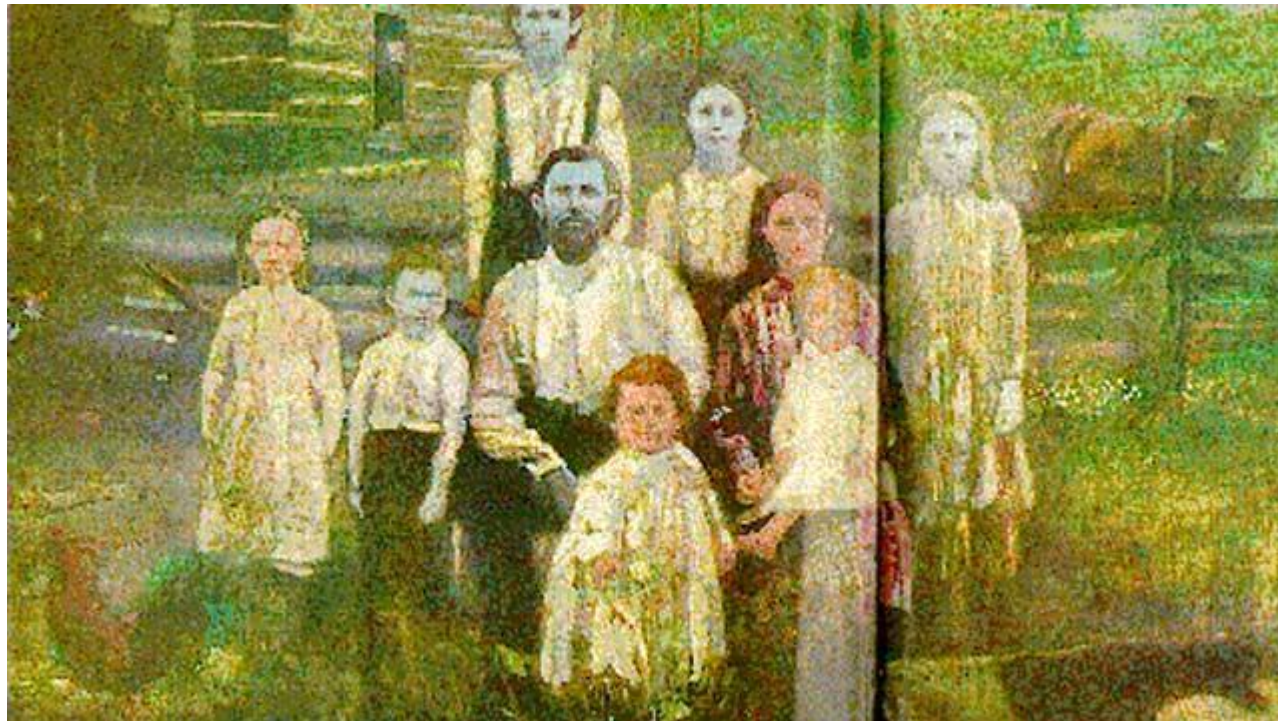
What are genetics and why are they important?



Notes

Genetics

What are genetics and why are they important?



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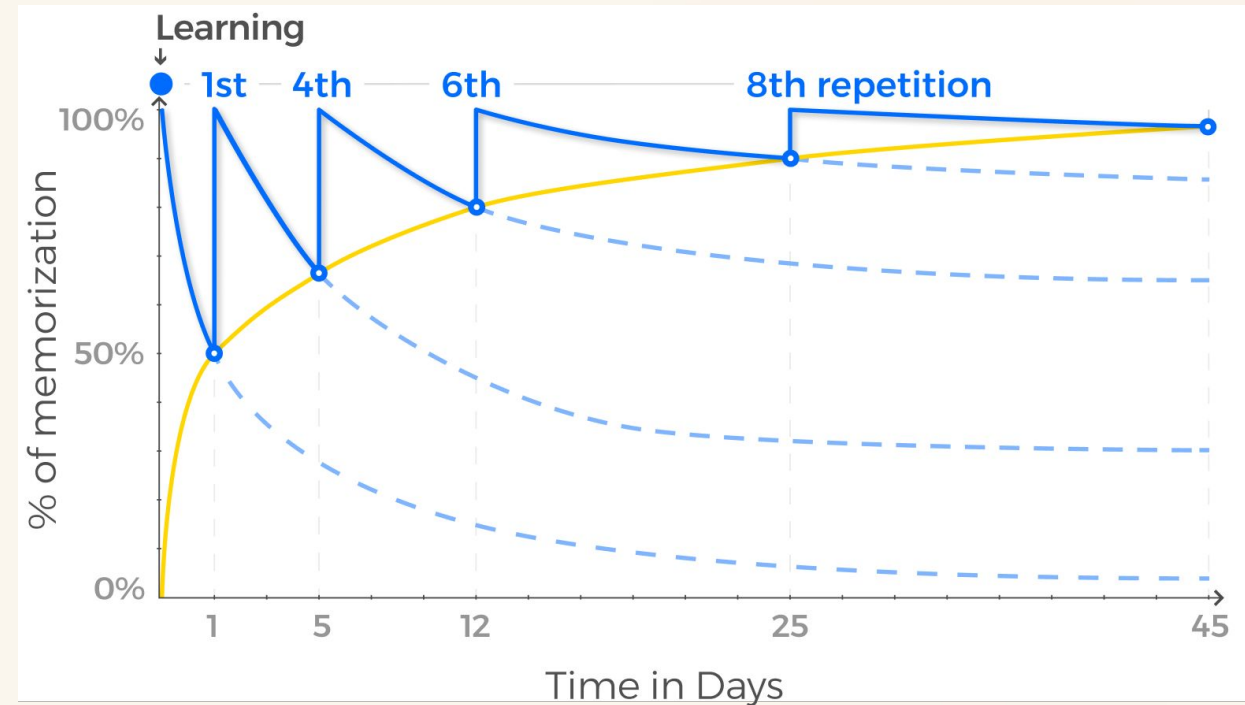
The Forgetting Curve

Flattening the Decay Curve

First mapped by Hermann Ebbinghaus in 1885, the forgetting curve shows that humans naturally **lose nearly 70%** of newly introduced information in a matter of hours if there is no retrieval attempt.

Every time you force a student to retrieve knowledge (via Strategy 7, 8, or 9), you interrupt the decay process, reset the curve, and flatten the angle of forgetting.

Retrieval practice makes information more retrievable because the path to the warehouse is actively cleared and widened.



The Spaced "Brain Dump" Playbook

1. Establish Core Anchors

Explicitly isolate the 5–7 foundational items students absolutely must know by the end of the unit.

2. Build Productive Failure

Run low-stakes practice using fun topics to build a safe classroom culture around trying and learning.

3. In-Class Application

When you start a new topic you need to break every few mins (3-5) and allow students to write, discuss or recall key points. Then as a formative require immediate recall of all key points, repeating the same procedure at the start and very end of class.

4. Explicit Itemized Transparency

Show students exactly how many gradable items exist within each prompt; teach what is essential vs. peripheral.

5. Systematic Retrieval Automation

Repeat open-answer processes on a systematic schedule to train the brain for long-term memory retrieval.



The Interconnected Mind



1. Attention / Input

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2. Processing / Connection

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3. Retrieval / Retention

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Practical Application

Practical, low-prep, high-impact strategies.



Phase 1: Attention & Input



Single-Focus Whiteboard

Strip your visual environment down. When teaching a core skill, ensure your board or screen contains only the specific problem or sentence under discussion. Clear visual clutter.

DR. SARAH OBERLE — INHIBITION



The "Speak or Show" Rule

Never present a text-heavy slide and read it word-for-word simultaneously. Processing verbal and visual tracks at the exact same moment causes immediate cognitive friction.

ZACH GROSHHELL — REDUNDANCY



Micro-Segmentation

Deliver direct instruction in tight, 3-to-5-minute blocks, immediately punctuated by active student execution. Constantly scan and reset visual focus to secure attention.

DOUG LEMOV — RADAR TECHNIQUE



Phase 2: Active Processing



Side-by-Side Twins

Split student worksheets in half: left column has a fully solved, step-by-step example; right column has an identical "twin" problem.
Offloads mental search strain.

ZACH GROSHELL — JUST TELL THEM



Live Raw Sketching

Avoid overly complicated pre-made graphics.
Draw simple hand-drawn timelines, box diagrams, or stick figures live on your board to anchor abstract verbal rules.

DUAL-CODING ALIGNMENT



Concrete Anchoring

Never present formulas or definitions in a vacuum. Connect abstract concepts to a universal, physical lived-experience for 60 seconds before displaying symbols.
Background knowledge!

GENE TAVERNETTI — TEACH FAST

Phase 3: Deep Retention



Index Card Brain Dump

Begin class with a blank index card. Give students 90 seconds to write everything they remember from yesterday's lesson with zero notes. Ungraded, low-stakes effort recall.

SEAN MORRISEY — BACKGROUND KNOWLEDGE



Spaced Review Sliders

Stop "mass-practicing" and dropping topics. In daily morning work, rotate three review questions: one from yesterday, one from last week, one from last month.

LAURA STAM — SYSTEMATIC REVIEW



Think-Pair-Share-Write

Never call on the first hand. Ask a question, enforce 10 seconds of silence, have partners whisper, and require everyone to write their final answer down.

DOUG LEMOV — EVERY STUDENT WRITES

THANK YOU

Reclaiming the Classroom

True instructional power doesn't come from a new app or a screen login; it comes from a strong, present teacher who respects biological cognitive architecture.

Take-Home Action

Keep your Cheat Sheet on your desk on Monday. Select just **one** routine to automate this week.



CONTACT US!

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with us
••••



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