Why we think with our hands

What the research says about gesture, manipulatives and moving from the concrete to the abstract, and why learners should build an idea before they write it.

1 The big idea, in plain English

2 Six findings, each with its study

3 What it means in a classroom

4 How Build It puts it to work

5 Every reference, checked

The big idea

We tend to picture thinking as words in the head. Watch anyone explain a route, a process or an argument, though, and their hands start moving. The psychologist Barbara Tversky argues, in *Mind in Motion*, that this is not a side effect. Her publisher sums up the case: spatial thinking is not a peripheral part of thought but its foundation, and our actions in real space get turned into mental actions on thought.

Language carries the trace of it. We push an idea forward, tear an argument apart, build a case. Abstract thinking borrows from what our bodies already know how to do.

For a classroom this is practical. When learners can hold, move and arrange the parts of an idea, and then fade from the objects to the words, they have a concrete route into something abstract. The research on gesture, manipulatives and concreteness fading points the same way.

55
studies comparing maths taught with objects against symbols alone, 7,237 learners

217
studies in a review showing spatial skills can be trained

0.47
average effect of spatial training, and it lasted and transferred

How to read the findings

Each finding is labelled with the kind of study behind it, because a single experiment and a review of 50 studies deserve different weight.

Meta-analysis	Pools the results of many studies. The broadest view, but it mixes settings and methods.
Trial or experiment	Compares a group that got the approach with one that did not. Stronger on cause and effect, narrower in reach.
Observational study	Measures what already happens in classrooms and looks for links. Shows a pattern, not a cause.
Review or theory	Draws the evidence together into an explanation that the other studies can test.

What the research found

1

EXPERIMENTS WITH CHILDREN

Moving your hands helps you learn

Children who were asked to gesture during a maths lesson learned more than children who were not, and children asked to make correct gestures learned most. In an earlier study, gesturing while learning helped children keep what they had learned, while speaking without gesturing did not. The authors: "We may be able to lay foundations for new knowledge simply by telling learners how to move their hands."

Source: **Goldin-Meadow, Cook and Mitchell (2009); Cook, Mitchell and Goldin-Meadow (2008)**

2

EXPERIMENT WITH CHILDREN

From action to abstraction

Third-grade children (Year 4) learned a strategy for equivalence problems through acting on objects, through a gesture that mimed the action, or through a more abstract gesture. All three helped on the problems they were taught. Only the gestures helped on new problems that needed the idea to be generalised.

Source: **Novack, Congdon, Hemani-Lopez and Goldin-Meadow (2014)**

3

LAB AND CLASSROOM EXPERIMENTS

Feeling it makes it make sense

University physics learners who briefly felt the forces of a spinning object scored higher on a later quiz than those who did not. The improvement was explained by activity in the brain's movement and touch regions when they later reasoned about the same idea.

Source: **Kontra, Lyons, Fischer and Beilock (2015)**

What the research found, continued

4

META-ANALYSIS

Objects help maths, if they are taught well

Across 55 studies and 7,237 learners, from kindergarten to college, teaching maths with concrete objects gave small to moderate benefits over teaching with symbols alone: moderate to large for remembering, smaller for problem solving and transfer. How the objects were used mattered as much as whether they were used.

Source: **Carbonneau, Marley and Selig (2013)**

5

SYSTEMATIC REVIEW

Start concrete, then fade

Rather than choosing between concrete and abstract materials, this review recommends beginning with the concrete and fading, explicitly and gradually, to the abstract. The concrete stage gives learners something to anchor the symbols to, and the fading strips away detail until the general idea is left.

Source: **Fyfe, McNeil, Son and Goldstone (2014)**

6

META-ANALYSIS

Spatial thinking can be taught

A review of 217 studies found that training improved spatial skills (average $g = 0.47$). The gains held when learners were tested later and transferred to spatial tasks they had not practised. Spatial skill strongly predicts achievement in science, technology, engineering and maths.

Source: **Uttal et al. (2013)**

What it means in a classroom

1. **Put the parts on the desk.** Before learners write an explanation or an argument, give them the parts to hold and arrange: one step, reason or clause on each piece.
2. **Move it, then say it.** Ask learners to try a different order and read it aloud. Hearing the change is how they decide which version says what they mean.
3. **Invite the hands in.** When a learner explains, let them gesture, and model gestures for relationships such as “balances”, “leads to” or “inside”.
4. **Fade on purpose.** Build it, talk it, then write it. Take the objects away in steps, so the structure moves from the desk into the writing.

How Build It puts it to work

Build It turns these findings into something learners can hold.

Blocks you can write on.

Writer’s Block puts the parts of a word, a sentence or an idea in front of learners, to move and say aloud before writing.

Two sizes of thinking.

Build the shape of a whole answer, one block per step, or one sentence, one block per part.

Concrete, then written.

Build It activities on the platform pair with the blocks, and the planner suggests a build to match the thinking a lesson asks for.

Our own evidence

Make It Count, the University of East Anglia’s Year 7 programme, was built on the Thinking Framework: over eight workshops learners tried talk tactics, graphic organisers and the blocks. Across four schools, the share of learners answering “I can” on the skills statements rose from **52% to 83%** (23 learners surveyed, 2024/25). The evaluators call the result indicative, because the group was small. It is a small study, and it did not test the blocks on their own.

Source: the University of East Anglia’s evaluation of Make It Count, 2024/25.

Read more, free: **Hands build understanding (research briefing)** structural-learning.com/research-briefings/hands-build-understanding

What teachers told us, and the limits

> “ **For the children, the fact that they are building and not writing is beneficial.**
>
> Karen Sivyer, primary teacher, Year 4 research project, 12 weeks

> “ **Students were clearly able to coherently organize their thought processes by interacting with the physicality of these blocks.**
>
> Dr Steve Connolly, Department of Education, University of Bedfordshire

From the Cambridge Hub impact study (2021). These are a teacher’s report and a researcher’s view, not a trial.

What this summary does not show

None of the studies in this summary tests Writer’s Block or Build It. Most of the gesture and manipulatives research is in maths and science, several studies are small laboratory experiments, and the benefit of objects depends on how they are taught. We have no controlled study of the blocks and writing yet, and we say so.

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