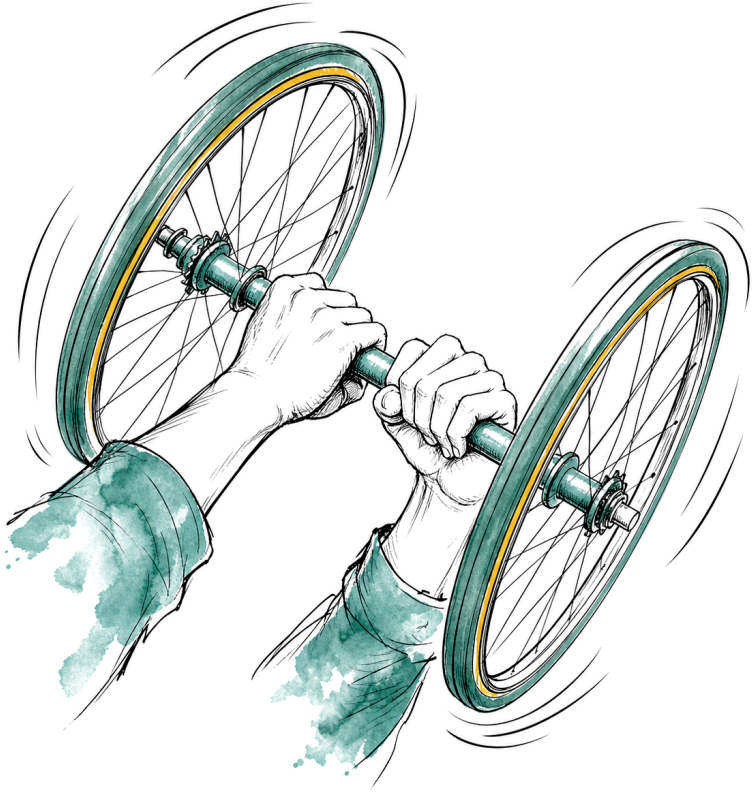
- For teachers planning hands-on demonstrations, especially in science

COGNITIVE SCIENCE: PHYSICAL & EMBODIED LEARNING

Does it matter if learners hold the equipment themselves, or is watching just as good?

New evidence from US university physics labs and one real undergraduate classroom, about ideas involving force and motion, translated for wider practical teaching.

In four US university physics experiments, learners who physically felt the forces of a spinning object scored significantly higher on a later quiz than those who only watched, an advantage explained by extra activity in the brain's movement and touch regions when they later reasoned about the same problem.



●●○ **Evidence: Promising**

Independent replications with UK primary or secondary learners, including non-kinetic subjects, would test whether the effect generalises beyond US university physics.

Kontra, Lyons, Fischer & Beilock (2015). 'Physical Experience Enhances Science Learning.' Psychological Science, 26(6), 737-749. doi.org/10.1177/0956797615569355

WHAT HAPPENED

Feeling the force beat watching someone else feel it

Across three lab studies and one real undergraduate physics class, one learner physically tilted a spinning double-wheel apparatus and felt the resistive force in their hands, while a partner only watched. In the real classroom, the group who felt the force themselves scored 76% on a later quiz on the same idea, against 69% for the group who only watched, despite the two groups' grades on other course quizzes being closely matched beforehand. Brain scans in a separate lab study showed why: the group who physically handled the apparatus showed more activity in movement and touch regions of the brain when reasoning about the same problem afterwards, and that activity statistically explained their better performance.

Watched someone else use it	**69%**
Held and moved it themselves	**76%**

Quiz scores from the real classroom experiment (Study 4, DePaul University introductory physics course). The gap was widest on the hardest questions, the ones requiring learners to combine two directions of force at once: 27% correct for the group who had felt it themselves, against 15% for the group who had only watched.

What the physical-experience group actually did

1

Held the real object, not a video of it

The learner gripped the spinning apparatus by the axle and tilted it themselves, rather than watching a demonstration or simulation.

2

Felt the resistance directly

Tilting the spinning wheels produced a real resistive force in the hands, the physical quantity the lesson was actually about.

3

Connected the feeling to the formula straight after

Right after handling the apparatus, learners completed a worksheet linking what they had just felt to the equations for the idea. Every learner eventually got a turn; the study only withheld it briefly, for comparison.

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MAKE IT YOURS

Across your subjects and classes

This was tested on US university physics learners studying force and motion, in the researchers' own words "areas of science in which kinetics come into play". These are sensible ways the same structure could work elsewhere, worth trying, not proven for your subject or your class.

Subject	How it could translate
Physics, D&T, engineering	The closest match to what was tested. Wherever you'd normally demonstrate a force, a mechanism or a moving part at the front of the room, let every learner get a hands-on turn with the real equipment first, then connect it to the diagram or formula.
Chemistry	Named directly by the researchers as a plausible extension. Let learners handle the real apparatus themselves, mixing, titrating, assembling, before you introduce the written equation for what they just did.
Maths (manipulatives)	A more speculative extension: this study didn't test maths, but the same principle, feel it before you formalise it, is worth trying with physical manipulatives for concepts like fractions, ratio or algebraic balance.
Geography, biology	Most speculative here. Handling a real rock sample, model or specimen rather than only viewing a photo or diagram is worth testing, but this study offers no direct evidence for non-kinetic topics.

Adapt it to the class in front of you

Quieter or less confident classes

A structured, turn-based physical task gives every learner a clear role, which can feel safer than being asked to answer aloud.

Livelier or lower-attaining classes

Keep roles and timing tightly structured, as the study did (a fixed set of trials, a clear actor and observer role), so the physical activity stays purposeful rather than chaotic.

Top set or higher-attaining group

This benefit showed up most on the hardest, most multi-step problems, so don't reserve hands-on time only for the basics; it may matter most for your most demanding content.

EAL or SEND learners

The study itself did not examine this group specifically. A physical channel that doesn't depend entirely on verbal explanation is a reasonable idea to test individually, not an evidenced result for this group.

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HOW SOLID IS THIS?

A well-designed study, not yet independently repeated

Developing

This rates the evidence's firmness, not our endorsement of the idea. Four converging experiments, including a real classroom trial and a brain-imaging mechanism, from one strong research team, on one specific kind of concept.

- Everyone in this research was a US university learner, in a physics lab or lecture course. No school-age classroom and no UK sample were tested, so this is a translation, not a school result reported directly.
- All four experiments tested one specific kind of idea: forces and motion. The researchers themselves say the benefit may be strongest for exactly this kind of "kinetic" concept, not necessarily for topics without a motion element.
- This is one strong, causally-designed study from one research group, not yet independently repeated by others, so treat it as a promising, well-tested idea rather than a settled method.

What that means for you: worth trying wherever your subject already involves a physical demonstration, the safest bet, honestly, is for concepts that genuinely involve force or motion.

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TRY IT THIS WEEK

Your first small step

THIS WEEK

Next time you'd usually demonstrate something at the front of the room, especially anything involving a force, a push, a pull or a moving part, ask whether every learner could get a physical turn with the real equipment instead.

Try it and watch: notice who engages with the idea afterwards who usually doesn't, and whether it's the hardest, most multi-step questions where it seems to matter most. That's your own evidence, not just the study's. The researchers' own words: *"brief, meaningful physical experience with science content enhances learning by activating sensorimotor brain systems used to execute similar actions in the past."*

Go deeper

Embodied cognition: why movement helps learners learn · structural-learning.com/post/embodied-cognition

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