

CHAPTER IV

Engagement as the Universal Signal

“There can be no mental development without interest.”

Alfred North Whitehead, “The Rhythmic Claims of Freedom and Discipline”

🍷 Free Throws in the Dark

Imagine learning to shoot free throws in a gym with the lights off. You shoot a hundred a day for a month. You can’t see the ball leave your hand or hear whether it hit the rim. At the end of the month, someone hands you a number: 22 percent.

That’s bad. It’s also all you know. Was it your elbow? Your knees? The release? Were you improving in week three and fell apart in week four, or were you flat all month? The number can’t say. And the month you could have spent fixing it is gone.

That’s roughly how we measure learning. We wait until the end of a long stretch, give a test, and get a number that says whether it worked, with no account of why, and long after the chance to steer has passed.

If you're learning anything right now (a coding language for work, Spanish for a trip, how to read a dense financial report without nodding off), you know the feeling from the inside. You read the same paragraph three times and wonder whether any of it is going in.

This chapter turns the lights on. It names the one signal that shows whether learning is working while it's still happening.

That signal is **engagement**: sustained mental investment in the thing being learned. It's a single measurement, readable at any zoom, from a moment to a year, and at any aperture, from one activity to a whole domain.

❧ The Measurement Problem

Learning is hard to measure while it happens. Steering it means making small decisions every few minutes. Do I reread this page or try a problem? Is this drill still doing anything? Has her attention gone, or is she thinking? Those decisions need information now.

Outcome tests have real uses, and Chapter 1 gave them theirs: they confirm, after the fact, that the direction was right. Used to steer, though, they work like a delayed autopsy. By the time the test shows you misunderstood Chapter 2 of the textbook, you're on Chapter 5.

The two systems make it harder still. Inquiry and Practice reinforce each other,¹ so their effects arrive tangled together. A test taken afterward sees only the blended result. When a student fails a physics exam, the score can't say whether Inquiry broke down (she never understood how mass and gravity relate) or Practice did (she understood perfectly and dropped a sign in the arithmetic she hadn't drilled). Still less can it say whether the two systems were feeding each other.

Researchers do separate those contributions, with long, repeated measurement over months or years, large samples, and careful statistics. That design is excellent for a journal and of no use at all to a parent or teacher deciding what to do on Tuesday afternoon. You can't run a six-month controlled trial on your own next hour.

Outcomes set from outside have one more problem: they measure what the outsider values. Whitehead drew this line a century ago in *The Aims of Education*, arguing that every examination question should be “either framed or modified by the actual teacher of that pupil in that subject.” The person who knows the learner should decide what counts.

So a usable signal has three requirements. It registers learning while learning runs. It's cheap. And it takes its reading without stopping the learning to do it.

What Engagement Is

Engagement may set off alarms. In software and corporate training, it has come to mean gamification: points, streaks, leaderboards, confetti bursting across the screen when you tap the right answer. Engagement, in that sense, means being entertained, and the people who distrust the word are right to.

The engagement in this book is **sustained mental investment in the thing being learned**: attention aimed at the material itself, and effort that holds when the material gets hard. Both parts count. The attention has to be on the thing, rather than on the wrapper around it. And the effort has to survive difficulty. The research literature calls this *cognitive engagement* (Jennifer Fredricks, Phyllis Blumenfeld, and Alison Paris, 2004). I'll just call it engagement. Whitehead put the premise in one line: “There can be no mental development without interest.”

Two children show what it looks like.

The first has just launched a model rocket to a record height. She's jumping, shouting, beaming, and already firing questions: did the angled fins make it spin, would a lighter engine have gone higher? High energy, visible joy, and a mind working hard on the physics of the rocket.

The second is bent over a hard puzzle. Brows down, jaw set, visibly frustrated. The room around him is loud and he doesn't look up. There's no joy on his face at all.²

Both children are giving off the same signal. Enjoyment may come with engagement or it may not. What marks engagement is the mind working on the thing. The second child's frustration is the sound of the gears catching: he's stuck, he won't let go, and he's testing and discarding ideas as fast as he can hold them. If you've ever felt that way learning something hard, the frustration was a good sign.

A few properties make engagement the right signal.

It **tracks learning**, because it's the learner's mind working on the thing itself.

It's **agnostic to method and to learner**. It doesn't care whether the approach is a lecture, a project, a drill, or a conversation, or what kind of learner is in front of you. It reads one thing: whether this learner's mind is working on this object.

And it's **hard to see from outside**. Chapter 1 drew the line between behavioral compliance, sitting still and looking pleasant, which is easy to see and easy to fake, and cognitive depth, which is neither. Reading engagement takes proxies, which this chapter comes to shortly.

What Drives Engagement

If engagement is the signal, the practical question is what raises it. Many things do, and they come from different places.

Four Core Drivers

Four come from the learning object itself and the learner's relationship to it. Each gets its own chapter.

Ownership. A learner thinks hardest about what's theirs. In Inquiry, ownership starts with the question. In Practice, it grows as the skill becomes the learner's own, so engagement with Practice should rise as mastery arrives.

Edward Deci and Richard Ryan's self-determination theory supports at least half of this. Their research found that intrinsic motivation, doing something for the satisfaction of the thing itself, depends heavily on

autonomy: the sense of being the author of your own actions. Chapter 2 suggested the loop runs the other way too, that sustained engagement deepens ownership, and that half remains a hypothesis to test.³

In the moment, ownership shows up as agency: whether the learner is pulling the activity forward or being pulled through it.⁴ You know the difference. Dragging yourself through a mandatory training video, you're being pulled, and holding your attention takes willpower you'll feel by the end. Fixing your own bicycle on a Saturday afternoon, you're pulling. You set the pace, and when you get stuck you go looking for the answer because you want it.

Fit. Ownership alone can still stall. Say you want, badly, to build your own phone app, and your only coding experience is customizing a social media profile fifteen years ago. You own the project completely, and within an hour you're lost.

Fit is the match between the task and the learner's developmental reach: challenge pitched just past what the learner can do alone. Two well-known theories describe the same sweet spot from two sides.⁵ Lev Vygotsky's zone of proximal development is the band between what a learner can do unaided and what they can do with a more skilled partner or a good tool. Mihaly Csikszentmihalyi's flow is what it feels like from inside when challenge and skill meet: absorption, time bending, self-consciousness gone.

Think of a gym. Curl a two-pound dumbbell and nothing changes; the muscle has no reason to adapt. That's boredom. Try to bench five hundred pounds on day one and the bar pins you. That's defeat. Fit is the weight that makes the muscle work hard, and grow.

Fidelity. How real and embodied the encounter is: real materials, real consequences, the learner's body and senses involved.⁶ You could own a task, at exactly the right difficulty, and still struggle to care about it as a flat simulation on a screen. Minds evolved in a physical world with weight, consequence, and immediate feedback through the senses, and they invest accordingly.

Worth. Whether the output matters and gets used, by the learner or by someone else.⁷ Picture a teenager learning mechanics, thermodynamics, and fluid dynamics by building a turbocharger for her own car. Now picture the same teenager taking a multiple-choice quiz on air-fuel ratios. The quiz produces a letter grade, entered in a ledger, and the paper goes in the recycling. The turbocharger gets bolted to an engine block. Get the numbers right and she feels the car pull harder. Get them wrong and it stalls in the middle of an intersection. Her work matters, it gets used, and her mind treats it accordingly.

The Wider Family

Many more drivers come from outside the object. People are social, mimetic, and playful, and these drivers work on all three:

- **Social:** competition, cooperation, an audience, admired people to imitate, belonging to a group, praise, the wish to impress someone the learner cares about.
- **Story:** narrative, mystery and suspense, play and make-believe, entertainment.
- **Structural:** grades, rewards and money, visible progress, streaks, leaderboards, deadlines, novelty.

These drivers are powerful, and few are simply good or bad. The same one can pull a learner deeper into the object or pull attention away from it. A leaderboard can send a child back to the fraction drill for one more round, or teach her to game the leaderboard. And a driver that starts outside the learner can become their own over time: the boy who joins the chess club to be near his friends can end up the one who stays after they've left. Sorting this family out takes three chapters of its own.⁸

Each core driver can be read on its own: does the learner own the work, does the challenge fit, how real is the encounter, does the output matter? Engagement itself is read from the learner. When engagement drops, the drivers are where a designer looks first.

• Reading Engagement: Zoom and Aperture

Engagement is one measurement, readable at any setting. Borrow two words from a camera.

Zoom is the time scale: a moment, a session, a week, a year.

Aperture is the scope: a single activity, one system, one learning object, a whole domain.

The same signal answers different questions at different settings. Zoomed in on one activity, it says whether this task fits right now. Opened up to a week, it says whether this week's work is taking hold. Wide open over a year, it says whether a learner is growing in a domain. The underlying state is the same each time. What it looks like from outside changes with the lens.

Reading Inquiry

Engaged Inquiry shows as a question that keeps growing. The learner follows it past the planned stopping point, builds guesses and tests them, and comes back to it later without being asked. When engagement fades, the questions stop, answers turn into guesses aimed at pleasing an adult, and the learner waits to be told.

A seven-year-old notices, on a winter walk, that the pond is frozen on top while water still moves underneath, and asks why the bottom stays liquid. At home she freezes cups of water on the windowsill and watches which part freezes first. Then she asks whether salt water freezes the same way, and tries that too. A week later, out of nowhere at dinner, she brings it up again.

Zoomed in, the signal is the next question arriving before the last one is answered. Zoomed out to the week, it's the return. Nobody assigned the pond. Her mind kept working on it in the background.

Reading Practice

Engaged Practice shows as care in the repetition. The learner sets their own standard, notices their own errors and corrects them, and keeps going without being asked. Engagement often rises as mastery arrives, because the skill is

becoming theirs. When engagement fades, the reps turn mechanical, speed replaces care, and attention drifts to the clock.

A ten-year-old is learning to ollie on a skateboard. Over a few weeks she makes hundreds of attempts. After each fall she adjusts her back foot. She asks a friend to film her so she can see what went wrong. The week it first lands, she practices more, not less.

Zoomed in, the signal is the adjustment after each miss. Zoomed out to the weeks, it's practice that grows as the skill arrives.

Reading the Mesh

One setting reads whether the two systems are meshing. Here the level of engagement alone tells you nothing, because engagement can run high inside each activity while Inquiry and Practice never connect. What tells you is the switch.

Every integrated activity moves back and forth between Inquiry and Practice. When the mesh works, the two run through the same object, sometimes within the same minute. So the reading follows engagement on the shared object, or on the connected region of the web it sits in,⁹ and watches what happens at each switch.

A working mesh carries engagement across the switch. The drill that follows a question stays engaging, because it answers something the learner wants to know. The question that follows a drill stays engaging, because the new skill opens it up. This holds when the next activity sits on a connected strand, even when it isn't the identical thing.

Parallel tracks reset engagement at the switch. Each activity has to win the learner's attention from zero, because nothing carries over from the last one.

Over time, track engagement on one object across a session, a week, a month. Engagement that holds or rises across switches marks a working mesh. Engagement that drops at every switch marks two tracks sharing a topic: the fractions lecture and the fractions worksheet from Chapter 2.

Outcomes still have their place. Tests and demonstrated skill remain the final check. Engagement steers in the moment; outcomes confirm, later, that the direction was right.

The switch shows whether the two systems mesh

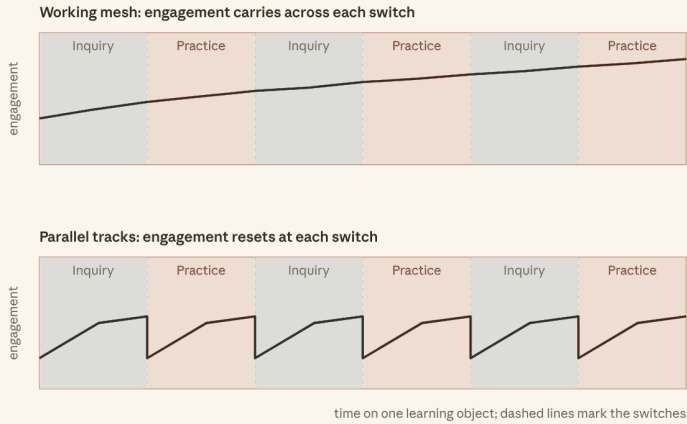


Figure 4.1 · reading the switch (schematic)

A schematic, without real data: in a working mesh, engagement on one object holds and rises across the switches; on parallel tracks, each activity starts again from low.

🔧 Proxies for Engagement

We can't plug a cable into a learner's head. Self-report fails quickly with young children ("Did you find that interesting?" "Yes."), and engagement is hard to see from outside. So the reading runs on observable signs. Here are five candidates, offered as working proxies rather than validated measures.

1. **Persistence after difficulty.** The learner keeps going when the task gets hard. It's the most direct sign of effort holding through difficulty, the second half of the definition.

2. **Unprompted questions about the object.** Questions nobody asked for, sometimes hours or days later, show the problem is still open in the learner's mind.
3. **Returning to the object unasked.** The girl at dinner, a week after the pond.
4. **Resisting interruption.** A learner deep in a problem is holding a lot in mind, and protects it. You've seen the child who says "wait, wait" without looking up.
5. **Explaining the thing to someone else, unasked.** To explain something, the learner has to take what they know apart and rebuild it in order. Doing that unprompted means the thing has become theirs.

Micheline Chi and Ruth Wylie's ICAP framework (2014) offers one structured way to classify signs like these. It ranks observable learning behaviors by how much thinking they demand: passive (receiving), active (manipulating), constructive (generating something new), and interactive (building on someone else's ideas in dialogue). Most of the five proxies sit in the upper two.

Reading these signs in the moment is also how a tutor decides what to do next.¹⁰ It's the relational skill Chapter 1 described, knowing a particular child's tells. And it can become a skill you use on yourself: noticing, in the middle of an afternoon's study, that you've stopped asking questions and started watching the clock.

Borrowed Instruments

Game designers and learning-analytics researchers already read engagement at scale, and several of their tools carry over.

- **Failure and drop-off analytics.** Where a learner stalls, and whether they come back after failing.
- **Dynamic difficulty adjustment.** Challenge tuned from failure rates to keep the learner in the band where it fits (Robin Hunicke, 2005).

- **Retention curves.** Whether the learner comes back tomorrow and next week, counted as returns to the object.
- **Transition analysis.** Where learners drop off between modes: a ready-made method for reading the switch.
- **Detection from interaction logs.** Educational data mining has built detectors that read engaged concentration, boredom, and confusion from logs alone, and that flag “gaming the system,” advancing without learning (Ryan Baker and colleagues). Confusion that gets resolved often drives learning (Sidney D'Mello and Art Graesser).

One caution applies to every instrument here. A measure turned into a target stops measuring (Goodhart's law). Optimize for time-in-app and you'll get time-in-app. An engagement metric stays honest when it's tied to the learning object.

Where Engagement Leads

Engagement is a state, read in the moment. Sustained over months, it leaves marks that last, and the marks differ by system.

In Inquiry, sustained engagement becomes **care**: questions carried for weeks, returns nobody asked for, a subject the learner keeps coming back to. In Practice, it becomes **craft**: the learner's own standards, fluency, and in time a style. The girl who kept bringing the frozen pond up at dinner is growing care. The skater who practiced more once the ollie landed is growing craft.

The Loop

I suggest the relation runs both ways. Engaged moments, repeated, build care and craft. And care and craft, once built, make engagement easier to reach: the learner returns unasked, persists through difficulty, resists interruption. Those are the proxies from a few pages back, which is why the return is the strongest of them. A return is engagement showing up on its own.

Engagement gives a reading in the moment. Care and craft are how its effects show over a season, and they give each system its own long-run sign. Both can be read from the record you already have (what the learner came back to, what standard they hold themselves to) with no new instrument.

Engagement and Capture

The claim holds only for engagement, the mind working on the object. There's a counterfeit. **Capture** holds attention without building anything. A slot machine keeps a player for hours and builds neither care nor craft. So does an endless feed. Chapter 9 draws that line carefully.¹¹

People, Too

The same holds for the people a learner works with. Engaged hours with an adult who brings care and craft of their own, repeated over years, become a relationship. And the relationship, in turn, makes engagement easier to reach.

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What Stays the Measurement

Engagement remains the signal, read at every zoom. Nobody measures care and craft directly. They're what the signal builds, kept high over months.

So turn the lights on in the gym. Watch the ball leave your hand. The signal was there the whole time.

Open Questions

- Which proxies track engagement reliably at each age?
- How quickly after a switch does engagement settle enough to read?
- Can software read these signs, or does it take a present adult?
- Does the loop between ownership and engagement hold equally for Inquiry and Practice?
- Does sustained engagement reliably become care and craft, and over what span of time?

If you’ve watched any of these play out, I’d like to hear what you saw.

📌 Notes

- 1. See Chapter 3.
- 2. See Chapter 5, on absorption without enjoyment.
- 3. See Chapter 2, “What Inquiry Requires.”
- 4. See Chapter 8.
- 5. See Chapter 5.
- 6. See Chapter 6.
- 7. See Chapter 7.
- 8. See Chapters 9 through 11.
- 9. See Chapter 2, “The Same Learning Object.”
- 10. See Chapter 8.
- 11. See Chapter 9, “Capture and Engagement.”
- 12. See Chapter 15, “Care and Craft.”

📌 Sources

SOURCE	USE
Jennifer Fredricks, Phyllis Blumenfeld, and Alison Paris, “School Engagement,” <i>Review of Educational Research</i> 74 (2004)	Origin of the construct (cognitive engagement)
Edward Deci and Richard Ryan (2000), self-determination theory	Autonomy and intrinsic motivation; support for the ownership-engagement link
Lev Vygotsky, the zone of proximal development; Mihaly Csikszentmihalyi, flow	Fit, described from two sides
Micheline Chi and Ruth Wylie, the ICAP framework, <i>Educational Psychologist</i> (2014)	Classifying observable signs of engagement
Robin Hunicke (2005), dynamic difficulty adjustment	Borrowed instruments

SOURCE	USE
Ryan Baker and colleagues, educational data mining; Sidney D'Mello and Art Graesser, confusion and learning	Borrowed instruments
Alfred North Whitehead, "The Aims of Education," in <i>The Aims of Education and Other Essays</i> (1929)	Examinations framed by the pupil's own teacher
Whitehead, "The Rhythmic Claims of Freedom and Discipline," in <i>The Aims of Education and Other Essays</i> (1929)	No mental development without interest

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