

## CHAPTER V

# Fit

### *Flow and the Zone of Proximal Development*

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*“What the child is able to do in collaboration today he will be able to do independently tomorrow.”*

Lev Vygotsky, *Thinking and Speech*

## • The Dial

You can study a chapter for four solid hours, highlighting every other sentence, feeling wonderfully productive, and remember almost none of it the next morning. Then you wrestle one stubborn problem at work for ten minutes, and the answer stays with you for years.

Why?

Picture an old analog radio, the kind with a heavy metal tuning knob. You turn it slowly. The speaker hisses and pops. Almost everywhere on the dial there's only static, and if you turn a hair too far past a station, you get a different, higher-pitched static. Then, at one narrow point, the noise drops away and a jazz quartet pours out of the speaker, perfectly clear. You can almost feel it lock into place.

Learning has a dial like that. The four hours of highlighting sat on the static. The ten minutes with the problem were tuned in.

The name for that narrow point is **fit**, one of the four core drivers of engagement.<sup>1</sup> Fit is the match between a task and the learner's developmental reach.<sup>2</sup> Two traditions describe it from opposite sides: the zone of proximal development from the teacher's side, flow from the learner's. Good fit sits at the edge of what the learner can do, and the edge is often uncomfortable. And the best fit does two jobs at once, holding attention now and building learning that lasts. Those two jobs sometimes pull apart.

## 🍷 Two Views of One Sweet Spot

### *The Teacher's Side*

Lev Vygotsky's **zone of proximal development** sounds like a textbook term, and the idea underneath it is simple. Picture a band of capability.

Below the band is everything a learner can already do alone. Assign work down there and nobody gains anything; there's no stretch.

Far above the band are tasks so complex that even the best expert in the world, walking the learner through every step, couldn't get them there. The learner doesn't yet have the vocabulary to use the help being offered.

The zone is the band between: what the learner can do, but only with guidance. Teaching, mentoring, and real development all happen inside it.

In 1976, David Wood, Jerome Bruner, and Gail Ross named that guidance **scaffolding**: support fitted to the learner and withdrawn as they take over. Think of dissolving stitches after surgery, or training wheels that come off once the child can balance. The whole point of the support is to make itself unnecessary. You build a temporary structure around the mind so it can reach higher than it could alone, then take the structure down, piece by piece, as the learner carries more of the weight.

### *The Learner's Side*

The zone of proximal development is the view from outside. What does it feel like from inside?

For that, Mihaly Csikszentmihalyi's **flow**. In office culture, "flow" has come to mean headphones on and notifications off. Csikszentmihalyi defined it as the experience of being fully absorbed in an activity. Its main condition is a match between challenge and skill. When the challenge is too low for your skill, you drop into boredom. When it's too high, you spike into anxiety. Flow lives in the channel between, and clear goals and immediate feedback help keep you there.

### *One Spot, Two Descriptions*

Put the two together. The zone of proximal development says where the task should be pitched: the target on the wall. Flow says what it feels like when the pitch hits. Between them, developmental reach gets both a location and a felt signature.

Kurt Fischer's dynamic skill theory adds a practical cousin. Fischer separated a person's **functional level**, what they do reliably on their own, from their **optimal level**, the best they can do with full support. The gap between them is close kin to the zone of proximal development. And Fischer showed the gap varies by domain and context.<sup>3</sup>

Take someone writing their first computer program. Alone, they can barely get the screen to say "Hello, world." With a patient senior developer at their elbow, they might assemble a small script to clean up a spreadsheet. That's a wide gap, and it needs heavy scaffolding. Now put the same person in a kitchen where they've cooked for twenty years. They chop, manage heat, deglaze a pan without thinking. Show them a demanding new French technique and they need a minute of help. Same person, a narrow gap.

So speed belongs to reach. You're fast or slow in this domain, at this moment.

### *Three Routes*

A nine-year-old walks into a climbing gym. The routes are marked with colored tape and graded by difficulty.

She starts on the easiest one. She's up it in thirty seconds, down in ten, and up it again, faster. By the fourth time she's climbing one-handed and looking around the room. The route has nothing left to teach her.

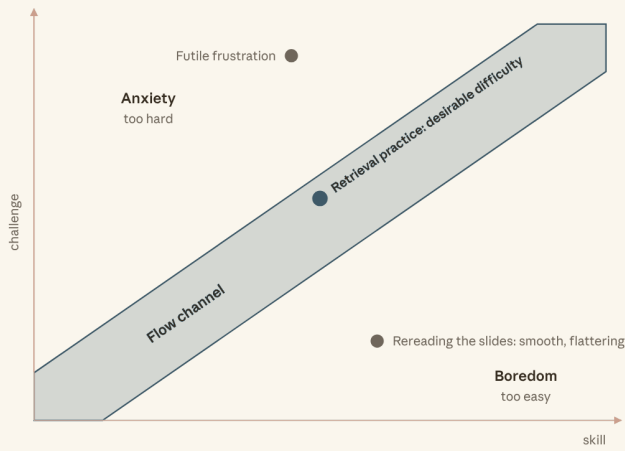
Next she tries one of the hardest routes on the wall. She can't get both feet off the floor. She tries twice, shrugs, and wanders off to the water fountain.

Then she finds a route two grades up from the first. She gets halfway, slips, and drops onto the mat. She stands there with her head tilted, studying the hold that beat her. She tries again and falls in the same place. On the fifth try she shifts her left foot higher first, and it holds. Forty minutes later she's still on that route, chalk to her elbows, and when her father says it's time to go, she says, "One more."

Same child, same afternoon, three very different levels of engagement. What changed was fit.

From the teacher's side, the easy route sat below her zone: she needed nobody. The hardest route sat above it: no amount of advice shouted from the floor would have gotten her feet off the ground. The middle route sat inside, where a well-timed "try your left foot higher" would have saved her four falls. From her side, the easy route was boredom, the hardest was anxiety, and the middle one was the channel, with a clear goal at the top of the wall and a hold that either took her weight or didn't.

Desirable difficulty sits at the upper edge of the channel



The zone of proximal development names the same band from the teacher's side.

*Figure 5.1 · the flow channel (schematic)*

Good fit aims at the channel's upper edge: hard enough to cost effort, close enough to meet with it.

## What Flow Is Made Of

In everyday speech, flow means having a great time. Deep absorption and fun, though, can come apart, and seeing why takes a look at how Csikszentmihalyi built his model. He described nine dimensions:

1. Challenge matched to skill
2. Action and awareness merging
3. Clear goals
4. Unambiguous feedback
5. Concentration on the task
6. A sense of control
7. Loss of self-consciousness
8. An altered sense of time

### 9. An experience worth having for its own sake

The last few are the ones people mean when they say they were “in the zone”: you sit down to work, look up, and it’s dark outside and you’ve missed dinner.

The dimensions don’t switch on together. When Gershon Tenenbaum and his colleagues analyzed the Flow State Scale in 1999, they found the dimensions arranged along a continuum. Some, like clear goals or the sense that the activity is rewarding in itself, show up readily whenever you sit down to something you care about. Others, like the vanishing of time or of self, appear only at the height of deep flow.

More recent work has simplified the picture. Cameron Norworthy and colleagues (2023) boiled the experience down to three core parts, **absorption**, **effortless control**, and **intrinsic reward**, with optimal challenge as the condition that makes all three possible. The field treats the full nine-dimension model with some caution, since critics argue it lacks precise definitions and testable causal claims. So the book leans on the best-supported core: absorption under optimal challenge.

### *Absorption Without Enjoyment*

Many research measures of flow track absorption without measuring enjoyment at all. You can be completely absorbed in a hard problem without enjoying it even a little.<sup>4</sup>

Picture a programmer six hours into hunting a single bug in a huge codebase. Her coffee went cold hours ago. She’s scowling, rubbing her temples. Ask her whether she’s having fun and she may throw something at you. Now look at her behavior. She hasn’t checked her phone since lunch, which she skipped. She’s stopped noticing her terrible posture. Her whole mind is fixed on the edge of what she can do. That’s flow, the gritty kind: high skill meeting a very high challenge.

Or a writer, pacing the room, rewriting the same tangled paragraph for the fiftieth time. Agitated, and entirely absorbed. Or the climber on her fifth fall, head tilted at the hold that beat her. She wasn’t smiling either.

Good fit and enjoyment are separate things. Your mind can be fully engaged, well challenged, and working at capacity while you feel real strain. Start a language or a new instrument expecting to grin the whole way, and you'll quit the first time it gets hard, convinced you're doing it wrong. The frustration you feel at that moment is your reach being pushed outward.

## ✿ Desirable Difficulties

Flow prizes smooth absorption. Building new skill is clumsy and hard. So there's a tension at the center of fit, and the psychologist Robert Bjork names it.

Bjork and his colleagues separate two things schools usually blur together. **Performance** is how well you do during practice: are you getting the flashcards right, hitting the notes in the practice room? **Learning** is what lasts afterward, the change in capability you still have days, weeks, or months later. Nicholas Soderstrom and Bjork (2015) showed that the two often diverge, sometimes sharply.

Say you're preparing to present to your company's board. You read through your slides for three hours. By the fifth pass you're flying through them, and your performance in practice is excellent. The next morning a director asks a question slightly off your script, and you can't recall the number on slide four. You practiced for performance.

Bjork's remedy is a set of **desirable difficulties**: conditions you build into practice on purpose. They make practice feel harder and lower your performance in the moment (you make more mistakes), and they improve long-term retention and your ability to use the skill somewhere new. Three are especially well studied.

- **Spacing.** Four one-hour sessions across a week, in place of one four-hour cram on Monday.
- **Interleaving.** Shuffling problem types, so you never know what's coming next, in place of twenty of one kind followed by twenty of another.

- **Retrieval.** Closing the book and pulling the answer out of your own memory, in place of rereading it. You recognize what you reread. Recalling it takes a separate, harder act. Staring at a blank wall trying to reconstruct the idea is uncomfortable, and that reconstruction is what builds the memory.

All three disrupt fluency. They keep the mind off autopilot.

### *Smooth Practice Flatters*

Smooth practice flatters the learner. It feels good. The streak on the language app grows and the scores stay high. It produces fluent performance now and weaker learning later, the pattern the book predicts whenever practice outruns ownership: you borrow the fluency of the moment without owning the skill underneath.<sup>5</sup> Do the same kind of math problem twenty times in a row and by the fifth you've stopped thinking. You're running a short-term routine, and nothing is being rebuilt.

Think of the difference between a straight desert highway on cruise control and a winding dirt road up a mountain. On the highway you feel fast and capable, and when you arrive you realize you can't remember the last hour of driving. On the mountain road you watch every rock and blind turn. It's slow and tiring, and your average speed looks terrible. A year later you could still describe every bend.

If fit meant comfort, practice would drift toward the highway, and the learning would fade.

### *The Resolution: The Edge, at Two Scales*

So how can a learner be smoothly absorbed and deliberately struggling at the same time?

First, good fit aims at the edge of reach, and the edge is uncomfortable by nature. Second, flow and desirable difficulty can coexist at different scales.

At the scale of the **whole activity**, the learner can be fully absorbed: committed to the goal, losing track of time. At the scale of **each rep** inside it, the work is effortful and pitched slightly past current fluency. The

programmer is absorbed in shipping the software. Every time the compiler throws an error, she meets a small, desirable difficulty, corrects, and goes on. The friction of each step doesn't knock her out of the absorption; the absorption carries her through the friction.

One condition holds it all together. A difficulty is desirable only when the learner can meet it with effort. A difficulty they can't meet, even with a hint or a mentor's help, sits outside the zone of proximal development. Then it stops being desirable and turns into futile frustration. The hardest route on the wall taught the climber nothing.

You can tell the two apart by watching how the learner responds to the friction. A desirable difficulty produces active problem-solving: a pause, a frown, a sigh, a new angle. Futile frustration looks like shutting down: guessing at random, staring blankly at the page. When effort stops being strategic and turns desperate or listless, the fit has broken. Step back, add scaffolding, and bring the edge closer.

## Fit in Inquiry and in Practice

### *Fit in Inquiry*

A well-fitted question sits just past what the learner can answer alone: close enough for a foothold, far enough to need a leap. Too easy, and it's answered before it becomes interesting. Too hard, and there's nowhere to start. Scaffolding in Inquiry leaves the answer with the learner. It narrows or reframes the situation until the learner can take the first step on their own, then steps back.

A six-year-old looks up at the night sky and asks why the moon changes shape. It's a wonderful question, and the full answer (orbits, spheres, the angle of reflected sunlight) is miles outside her zone. Draw her a diagram of the moon's orbit and her eyes will glaze over in five seconds. Tell her a monster takes a bite out of it every night and you've killed the question on the spot.

So her father takes the shade off a lamp, sets it in the middle of a dark room, and hands her a foam ball on a stick. Hold it out in front of you, he

says, and turn slowly in a circle, watching the ball. As she turns, the lit part of the ball swells from a sliver to a full circle and shrinks back again. She stops with the ball half lit and says, “That’s the half moon!”

The question stayed hers, and the discovery too. The lamp and the ball gave her a way in.

### *Fit in Practice*

Well-fitted Practice is pitched at the edge of the skill: hard enough that errors happen, easy enough that the learner can notice them and correct them. A learner making errors they can’t even detect is cementing bad habits. Two mechanisms keep the fit: mastery thresholds, which keep the learner from moving on too early,<sup>6</sup> and desirable difficulties, which keep the reps from turning smooth and flattering.

A twelve-year-old keeps trying to play a fast piano passage at full performance speed, and keeps stumbling. Drilled that way, she’s practicing her mistakes. At that tempo, the passage is outside her reach.

So she slows it down, to a tempo where she makes an occasional error and can hear it, stop, and fix the fingering. The passage becomes practicable. That’s the scaffold. The mastery threshold: she raises the tempo a few beats only when the slower speed holds clean. And the desirable difficulty: she doesn’t drill that one passage for an hour. She plays it, switches to a scale, works on another piece, and comes back. Each return makes her reload the pattern from scratch, and that reload is what makes it stick.

### *Two Edges on One Object*

Inquiry and Practice on the same object can have very different edges.

Remember the stick shift from Chapter 2. The Inquiry side, how a clutch works, how the gears engage, what the friction point is, a learner may grasp in ten minutes. Explain the plates meeting and she nods. Her edge in Inquiry is high. The Practice side, easing the clutch out with her left foot while pressing the gas with her right, is another matter. You can understand the physics of a

clutch perfectly and still stall five times at the same stoplight. Her edge in Practice is much lower.

Good fit sets each system at its own edge. You don't hold back her questions because she keeps stalling, and you don't assign her an essay on transmissions because she finally made it into second gear. And because the two systems reinforce each other, progress on one moves the edge of the other.<sup>7</sup> Once the clutch is automatic, she has the attention free to ask how to downshift smoothly into a corner.

## Fit, Engineered: Adaptive Education

The lamp and the ball, the slowed tempo, patience with the stalling clutch: all of it relies on an observant adult who reads a learner's face and adjusts. Millions of people now learn through apps and software. What happens when we try to engineer that judgment?

Adaptive education is fit turned into engineering: systems that adjust instruction to each learner as they go. Decades of building them offer five lessons.

### 1. Adapt to Capability

For decades, researchers looked for matches between teaching methods and learner traits, known as aptitude-treatment interactions. Lee Cronbach and Richard Snow (1977) found robust, repeatable matches very hard to come by.

The popular modern version is **learning styles**: you're a visual learner, or auditory, or kinesthetic, and you learn best when teaching matches your style. It's everywhere, in schools, universities, and corporate training. It feels personal, and it offers a tidy category (and a handy excuse for the compliance module you failed). Call it the astrology of education.

But surely, you might say, I really do learn faster from a chart. Preferences are real; nobody disputes that. What Harold Pashler, Mark McDaniel, Doug Rohrer, and Robert Bjork asked, in a 2008 review, was whether *matching* instruction to a preferred style improves learning. They found no adequate

evidence that it does. Well-structured material tends to work for learners of every stated style.

What holds up is adapting to **prior knowledge**. Slava Kalyuga, Paul Ayres, Paul Chandler, and John Sweller (2003) documented the **expertise reversal effect**: methods that help novices can hinder more advanced learners. A fully worked example, every step of a hard engineering problem written out, is perfect scaffolding for a beginner. Hand the same example to someone who already knows the steps and it slows her down. Her mind has to wade through redundant material, which crowds working memory. Her edge is higher, and she needs the bare problem.

Fit tracks developmental reach, and reach is about capability: where this learner is, in this domain, today.

## *2. Engagement Stays Agnostic*

The engagement signal reads whether the learner's mind is working on the object. It needs no theory of learner types.<sup>8</sup> If a preference genuinely helps, it shows up in the reading.

Preference and engagement are different things. Learners almost always prefer what feels easy and fluent, and, as with the board presentation, fluency can fool them into thinking they've learned. Survey a student after an evening of rereading and she'll say she liked it, while her engagement was low. She may dislike self-testing, because it's taxing and exposes what she doesn't know, while her engagement runs high. Ask her what she liked and she'll point you the wrong way. Watch her, and you'll see.

## *3. Adaptive Tutoring Works, at Two Zooms*

Kurt VanLehn's 2011 review found that human tutoring raised scores by about 0.79 standard deviations over no tutoring, and that well-built step-based tutoring systems came close, at 0.76.<sup>9</sup> An effect of 0.79 moves a student from the middle of a class to roughly the top fifth.

VanLehn describes these systems as running two loops. An **outer loop** chooses the next task. An **inner loop** responds at each step inside it: a hint here, feedback there. Fit is set at both zooms, the task and the step.

Evidence from K–12 mathematics adds a caution. Tutoring systems showed small effects over short periods and larger ones after a full school year or more (Saiying Steenbergen-Hu and Harris Cooper, 2013). Fit compounds, and it takes time to show.

*4. Estimating Reach*

Software finds the edge by estimating it. Models such as **knowledge tracing** (Albert Corbett and John Anderson, 1995) estimate, skill by skill, how close a learner is to mastery, updating with every answer. When the estimate says a skill is nearly mastered, the system moves on. When it says the learner is guessing, it steps back.

*5. The Gap Is Inquiry*

Nearly all adaptive systems adapt Practice: which problem next, how hard, when to review. Very few adapt Inquiry: which question to pose, how to narrow it when the learner is stuck, how to reframe it when it's too easy. No software yet does what the father with the lamp did.

Adaptive Inquiry is largely unbuilt. It's where the model points.

 Reading Fit

Fit shows in the learner, and you can read it in the moment, with the same eyes that read engagement.<sup>10</sup>

| FIT      | WHAT YOU SEE                                                                                                             |
|----------|--------------------------------------------------------------------------------------------------------------------------|
| Too easy | Speed without attention, rushing, boredom, drifting off. The climber going up the easy route one-handed.                 |
| Too hard | Freezing, random guessing, giving up, frustration that doesn't resolve. The climber wandering off to the water fountain. |

| FIT | WHAT YOU SEE |
|-----|--------------|
|-----|--------------|

|             |                                                                                                                                                                                             |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| At the edge | Effortful absorption: errors followed by corrections, pauses to think, persistence through difficulty, small wins that arrive after real work. The climber studying the hold that beat her. |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Adjusting fit is the most frequent move a tutor makes, many times an hour: a hint, a harder variation, a slower tempo, a narrower question. Each one is a small turn of the dial, back toward the narrow point where the static clears.

## • Open Questions

- How far past the learner's current reach should the edge sit, and does the answer change with age?
- Do desirable difficulties hold for young children, or mainly for older learners who can tolerate the discomfort?
- Can software set fit for Inquiry as well as it already sets fit for Practice?
- When Inquiry and Practice on one object have different edges, how far apart can they drift before the two systems stop reinforcing each other?

## • Notes

1. See Chapter 4.
2. See Chapter 2, "What Inquiry Requires."
3. See Chapter 13, "Why Each Line Must Be Raised on Purpose."
4. See Chapter 4, "What Engagement Is."
5. See Chapter 9, "The Long Run."
6. See Chapter 12.
7. See Chapter 3.
8. See Chapter 4, "What Engagement Is."
9. See Chapter 15.
10. See Chapter 4, "Proxies for Engagement."

## Sources

| SOURCE                                                                                                                   | USE                                                           |
|--------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|
| Lev Vygotsky, <i>Mind in Society</i> (1978)                                                                              | The zone of proximal development                              |
| Lev Vygotsky, <i>Thinking and Speech</i>                                                                                 | Epigraph                                                      |
| David Wood, Jerome Bruner, and Gail Ross, <i>Journal of Child Psychology and Psychiatry</i> (1976)                       | Scaffolding                                                   |
| Mihaly Csikszentmihalyi, <i>Flow</i> (1990)                                                                              | Flow and the balance of challenge and skill                   |
| Gershon Tenenbaum, Gerard Fogarty, and Susan Jackson, <i>Journal of Outcome Measurement</i> (1999)                       | Flow dimensions as a continuum                                |
| Cameron Norsworthy and colleagues, <i>International Journal of Applied Positive Psychology</i> (2023)                    | Three core dimensions of flow                                 |
| Elizabeth Bjork and Robert Bjork (2011); Nicholas Soderstrom and Robert Bjork (2015)                                     | Desirable difficulties; learning versus performance           |
| Kurt Fischer, <i>Psychological Review</i> (1980)                                                                         | Functional and optimal levels                                 |
| Lee Cronbach and Richard Snow, <i>Aptitudes and Instructional Methods</i> (1977)                                         | Aptitude-treatment interactions                               |
| Harold Pashler, Mark McDaniel, Doug Rohrer, and Robert Bjork, <i>Psychological Science in the Public Interest</i> (2008) | Learning styles: no adequate evidence for matching            |
| Slava Kalyuga, Paul Ayres, Paul Chandler, and John Sweller, <i>Educational Psychologist</i> (2003)                       | The expertise reversal effect                                 |
| Kurt VanLehn, <i>Educational Psychologist</i> 46 (2011)                                                                  | Effects of human and computer tutoring; outer and inner loops |
| Saiying Steenbergen-Hu and Harris Cooper, <i>Journal of Educational Psychology</i> (2013)                                | Tutoring systems in K–12 mathematics; duration matters        |
| Albert Corbett and John Anderson, <i>User Modeling and User-Adapted Interaction</i> (1995)                               | Knowledge tracing                                             |

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