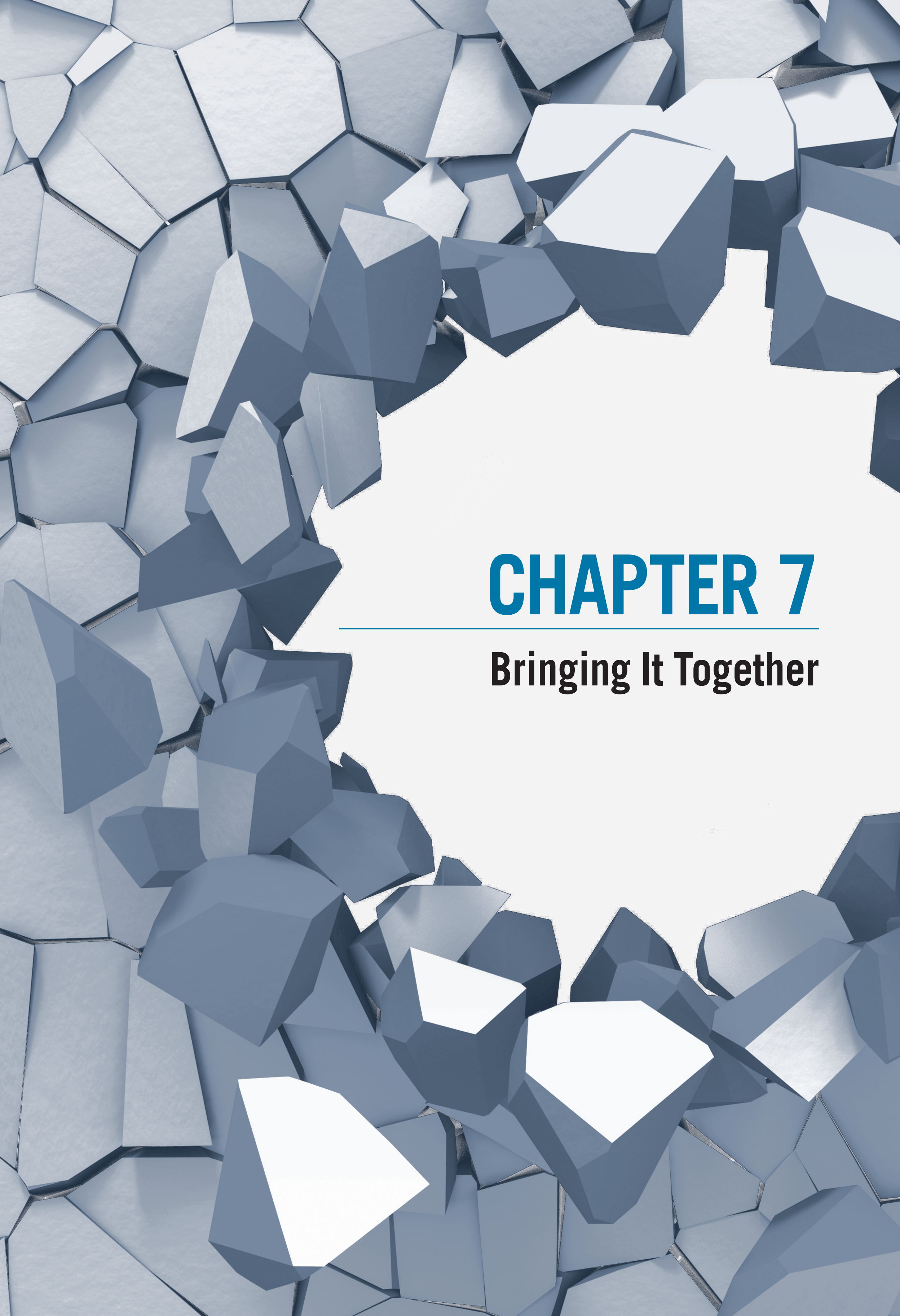


CHAPTER 7

Bringing It Together

"Rabbit's clever," said Pooh thoughtfully.
"Yes," said Piglet, "Rabbit's clever."
"And he has Brain."
"Yes," said Piglet, "Rabbit has Brain."
There was a long silence.
"I suppose," said Pooh, "that's why he never understands anything."

—A. A. Milne, *Winnie the Pooh*[1]

Talk of education technology can carry more than a whiff of A. A. Milne's clever Rabbit. There's a lot of Brain out there—overheated, self-impressed conference presentations and dismissive hand waving toward those who just "don't get it." Technology enthusiasts and vendors offer sophisticated, seemingly big-brained promises and plans. They talk in an impressive jargon about technically complex stuff, tossing around references to "immersive environments," "available bandwidth," "hybrid models," and the rest. Indeed, many enthusiasts talk of a "digital revolution" that will sweep away all that we know about classrooms, schools, and systems. Meanwhile, critics fret that new technologies are a threat to teacher professionalism or an assault on the fabric of schooling. Amid all this noise, educators can find themselves uncertain as to what they should make of it all or what's really changed.

We don't know about you, but we find ourselves scratching our heads at a lot of the heated back-and-forth. We've no patience for the notion that education technology is going to magically transform schooling. At the same time, we're befuddled by critics who lament the "invasion" of technology. We can't remember the last time someone seriously suggested that a new X-ray machine or drug regimen was going to render doctors superfluous. Nor can we think of many physicians who complain that CAT scans or lasers threaten to "de-skill" their profession. Instead, when it comes to medicine, we seem pretty comfortable recognizing that technology can provide valuable capabilities but that these are limited—and that new tools are most helpful when they complement and enhance the efforts of skilled professionals.

While we're on a roll, we can't think of many college professors who complain that books have "de-skilled" their teaching—or, alternatively, many reformers who suggest that books are a miraculous substitute for instruction. Heck, while educators once looked askance at the book, today a school that failed to provide books would be regarded as failing to provide the basic tools for learning.

That seems to us the sensible way to think about technology: as a *tool* for learning, one most likely to matter when wielded by skilled professionals.

Meanwhile, a surprising amount of success with education is of the accidental variety, and stands to benefit from the more consistent and purposeful application of learning science. As we've seen, Salman Khan, founder of the Khan Academy, started out by trying to help members of his extended family get better at math without having to personally tutor each of them. He made videos so that he could better leverage his time—yielding a final product that included only his voice-over with a video. It was a happy accident that led to separated audio and visual information, with almost no distracting visuals, a technique shown to accelerate mastery. Meanwhile, by making those friendly, straightforward instructional videos available 24 hours a day, seven days a week, Khan provided an accessible resource for confused learners with nowhere else to turn. The approach is hardly perfect, but it is promising, especially since Khan Academy has solicited feedback, modified its offerings, and begun to run controlled experiments to see what's working and what's not.

Inattention to learning science can lead to missteps and missed opportunities. For instance, many multimedia offerings wind up stuffed with music, videos, or chat boxes, when learning science teaches that less cluttered designs would do more for learning. Intrigued by the enthusiasm for online learning, some college faculty members are now delivering their instruction essentially "as is" to tens of thousands of online participants. Unfortunately, many of these high-powered college faculty members have little or no familiarity with what's known about learning or what that means for education technology.

Peter Norvig and Sebastian Thrun, Stanford University computer science professors, delivered one of these early, incredibly popular online courses. In fall 2011, they taught an online version of their "Introduction to Artificial Intelligence" course—more than 150,000 students started the course (about 20,000 finished).[2] Technology makes this kind of thing possible: The course was affordable (free!), reliably delivered, available 24/7, and capable of being both customizable and data-rich. A terrific start.

In 2012, Norvig delivered a TED talk about designing the course. Some of what he had to say aligns with learning science ("keep the audio informal" and "don't just focus on facts and memorization"), but much that a learning engineer might hope to hear was absent. There was no evidence, for instance, that they tried to systematically tap what research has to say about the value of worked examples or the importance of demonstrations.[3] Now, this is not to particularly criticize Norvig and Thrun—after all, their course features terrific elements, including a better integration of practice than most free online offerings. However, design matters more and more as one's "classroom" gets exponentially bigger—and using a new medium, despite creating fresh opportunities, makes it likely that some old strengths may not translate. The power and peril of technology are that it facilitates the delivery of well- or poorly designed instruction to many more students, more easily, and more rapidly. Educators need to behave accordingly.

Let's be clear about something. Throughout this book we have occasionally sounded critical notes when discussing innovators whom we admire and technologies we value. We do not believe it is useful for learning engineers to be either cheerleaders or cynics. Rather, as with the pathbreaking efforts of Norvig and Thrun, we should value new offerings and possibilities, but with a commitment to constantly asking where innovations fall short, where they're incomplete, or how they might be improved. There *is* a body of knowledge out there to tap—we wish more folks were not *accidentally* doing good work, but *systematically* doing terrific work by taking full advantage of that knowledge.

After all, it's not always clear that fashionable ideas actually tie back to better learning. At the same time, as we've seen, there are schools and systems that illuminate a more promising course and where educators focus on learning design rather than gadgetry. As Kerry Muse, chief learning officer and head of school for Venture Academy, a blended school, explains, "You're not just adding or overlaying technology onto a program that already exists. . . . You have to completely shift what you think about what a traditional class looks like."

Let's return to the physician example: Doctors don't go for quick solutions to surface symptoms. If you went in for a checkup and your physician found high blood pressure, you wouldn't want her to say, "If we drain a pint of blood, we'll have your blood pressure down in no time." We'd call that malpractice. We'd instead expect her to be an expert at using the science to pick from a wide array of technologies to diagnose and help us. We should have similar expectations for technology use in schools.

THREE BIG THINGS TO KEEP IN MIND

As we survey the shifting landscape of 21st century learning, educators are buffeted by a dazzling array of new devices, computer simulations, and portable projects. If we step back, though, we can see these in context, as interesting variations on more familiar themes. Let's take a moment to focus on three broader trends that will continue to evolve in accord with the culture, technology, and the larger economy.

Technology and Teachers

Think back to our earlier discussions of the book. The book freed the teacher from the tyranny of the lecture and the student from utter dependence on his teacher's personal store of knowledge. The impact of this development, though, depended entirely on how capably and purposefully educators and students used these books. A bad book still requires clarifying lectures—and good books help only if students read them.

Technology's impact is minimized when it involves the same teachers doing the same things in the same way as they did before. Think about medical technologies like the X-ray, the stethoscope, or the MRI—advances in medical technology have gone hand in hand with specialized understanding about how best to use them. If doctors equipped with the X-ray machine insisted on still processing the film themselves, their ability to use this new tool to help more patients would be drastically limited. And if those doctors insisted on hand-assembling their own X-ray machines, the whole invention might be seen as an unfortunate distraction.

If students have access to riveting computer-assisted instructional information, demonstration, and "worked examples," the mix of what teachers need to do should change. This entails rethinking a teacher's job description, responsibilities, training, expectations for change and personal growth, and evaluation. If new practices incorporating technology are effective, teachers should be expected to learn and adopt them, just as physicians and medical education are expected to keep pace with new advances and improved treatments.

We need to think differently about how teachers are prepared and supported. It's likely that the skill sets required to teach an online course may look somewhat different from those in traditional classrooms and that therefore support and training ought to vary accordingly. It's hard to say much more on that right now because neither online providers nor training programs have begun to seriously explore what this will require. More fundamentally, whether online or in traditional classrooms, the opportunity for teachers to spend less time conveying content and more time coaching students should have big implications for teacher schedules and duties.

Today's systems for teacher evaluation lean heavily on value-added metrics that evaluate a teacher's impact on reading and math scores. Without wading into the debate about the merits or frailties of such an approach, let's note that these systems work best when one teacher "owns" a class of students for a full academic year. The more teachers are sharing instructional responsibilities, the more students are instructed by online providers, the more tutoring is delivered by someone other than the teacher, and the less rigidly students are organized in traditional classrooms for an academic year, the less these kinds of metrics reflect an individual teacher's performance. This means that state, system, and school leaders will want to reconsider the smartest ways to gauge the performance of individuals or teams.

School and Home

Centuries ago, the introduction of the book enabled teachers and students to "flip" the classroom so that students could learn outside as well as inside a classroom. In important ways, this started to blur the line between school and home. It made it possible for

Abraham Lincoln to (pretty successfully) educate himself on the Illinois prairie and meant that the education of a given student was no longer quite as dependent on the physical presence and quality of the teacher.

Of course, the Internet has taken this phenomenon to a whole new level. Online learning blurs the line between home and school (and even the bus ride between them). It means that learning is no longer anchored to the school building and its resources.

One of us recalls working on the design of a virtual K–2 reading program nearly 15 years ago. At the time, it would have been cheapest just to use one of the popular "basal reading" programs. However, none of those programs made full use of the existing research or technology or really leveraged what could be done in a home environment by an adult working closely with a child. So the development team built an entirely new research-based reading program, one that allowed adults at home to work with students and virtual teachers. The program actually used very little technology for students in K–2, due to their age—the technology was mostly to help the adults to understand the activities they were supposed to do with the students. This kind of blurring of home and school was tougher then but has become increasingly easy thanks to more modern technology.

This profoundly expands the amount of time that children might spend learning in comfortable, personalized settings. If providers design interactive environments with sufficient skill and panache, children can choose to massively increase the amount of time they spend mastering concepts and content from their bedroom, a friend's room, or the local Starbucks. If we just consider the hours that school-age kids spend playing popular video games and find ways to entice them to willingly channel an hour a day of that time into more academically fruitful paths, it could be the functional equivalent of adding perhaps *six weeks* of extra instruction to the typical school year.

This also raises the possibility that disparities in learning will widen between children from educated, more affluent households and those in less fortunate circumstances. If wealthier households have newer, more powerful digital devices *and* take smart advantage of them, the increased availability of digital tools may do nothing to help disadvantaged students catch up to their peers. That's doubly true if more affluent and educated families are those that make the best use of new tools. Such challenges will go unaddressed if we simply place blind faith in the miraculous power of "learning technology." Realizing the full potential of blending home and school for students in the most challenging circumstances will require educators to be at the top of their game.

Data and Competency

The air is full of high-flying talk about data-driven decision making. The truth is that much valuable data often fall short of helping to inform the learning process, even if they serve to evaluate institutions. After all, the once-a-year model of assessment severely limits how much we can learn about what might have helped certain students master a particular set of skills or knowledge. It makes it tough for schools or systems to do much to adapt in a timely or agile manner.

There are vast new opportunities to revamp what it means to collect and leverage data. After all, ventures like Amazon and Facebook are not collecting data on their millions of users once a year; they're collecting that data every minute, using what they learn to constantly tweak their models, algorithms, and offerings. But such a mind-set requires wholly new habits of data collection and use.

Instances of such models are already present in schooling—it's just that they're not widely used. At a place like Florida Virtual School, which is enrolling new students just about every day of the year, the opportunities for continuous learning are radically enhanced.[4] Many of the new university-level free MOOC (Massive Open Online Course) offerings talk explicitly about the vast amounts of data they're collecting, right down to the "clickstreams" the users engage in as they interact. Researchers at the Pittsburgh Science of Learning Center and at Worcester Polytechnic University have begun to use this rich trove of data to look for patterns and problems in online learning, and adjust student activities accordingly.

With the wealth of data that's newly available on student mastery, it's increasingly possible to differentiate learning in systematic ways—even if the teacher isn't a miracle worker. This creates new possibilities for organizing instruction; deploying teachers; and making use of computer-assisted instruction, assessment, and practice. It becomes possible to track student mastery and give feedback to teachers and schools on a continuous basis. Models like the School of One show how students can be assessed and given additional instruction and practice in real time, accelerating mastery and supporting motivation and a sense of efficacy. Places like Mooresville and Rocketship Education are showing how, even in a relatively familiar brick-and-mortar setting, schools can leverage information, instructional supports, and thoughtful grouping to address students with varying needs in smarter and more customized ways.

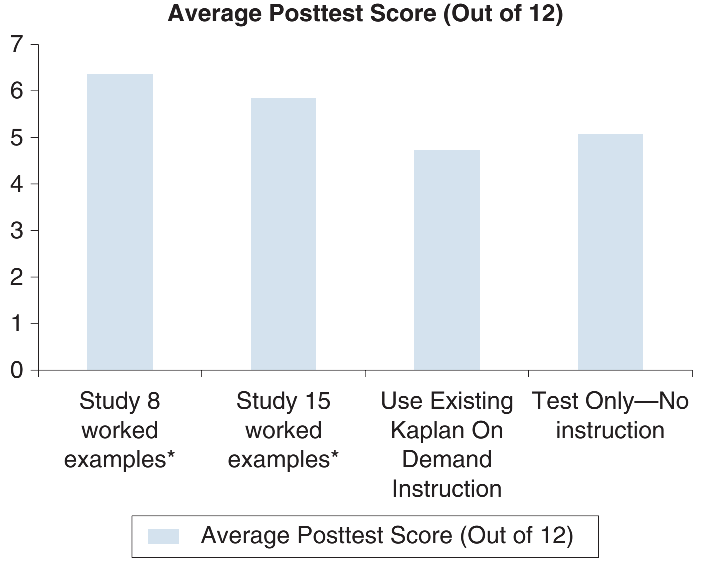
EVERY TEAM NEEDS LEARNING ENGINEERS

Getting learning engineers engaged in school improvement can make all the difference, especially when it comes to thorny questions of technology or redesign. For example, a team at Kaplan working on new test prep materials for the LSAT produced an hourlong instructional video for one of the hardest parts of the test, the logic puzzles. (We'll leave the issue of what logic puzzles have to do with becoming a good lawyer to others.) That video seemed like a terrific idea. The video was available on the web, inexpensive to download, and always there—what's not to like?

At that point, a learning engineer got involved. Tapping research on "worked example" problem solving, he worked with the team to design an alternative resource. The team crafted less than 20 different guided problems, basically using low-tech PowerPoint slides—but drawing on learning science. The learning engineer arranged for a quick controlled trial with several hundred online test-takers, comparing the performance of students with no training, those who just watched the video, and those who had the worked-example training.

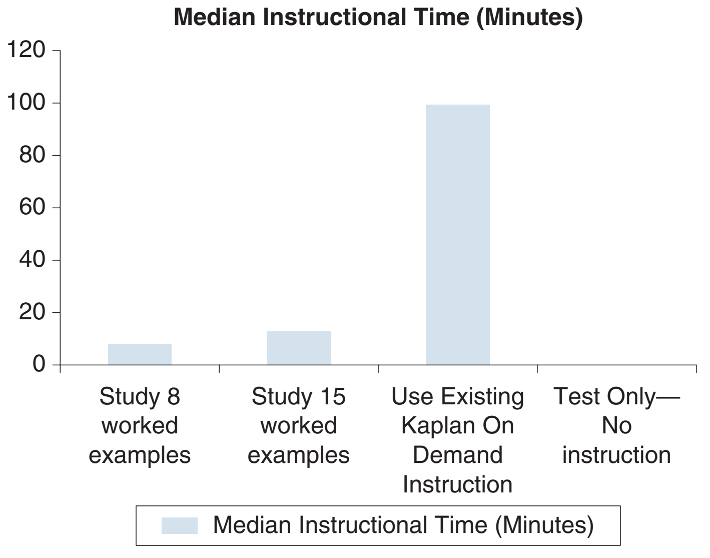
The result? Students who used the cheaper, quicker worked examples outperformed those who watched the more expensive-to-make, more time-consuming video. Moreover, the exercise shifted the team's focus away from a generic fascination with technology toward the learning research, and it reinforced the idea of rapidly piloting ideas rather than just debating them.

Kaplan Test Prep Study Results, Student Performance



*Significantly different from no instruction, p<.05, N>80

Kaplan Test Prep Study Results, Student Performance



Better learning, less student time, lower cost? That's not a bad combination. But school and system leaders can't do all of this work by themselves. They need to tap learning engineers who can help. Unfortunately, that doesn't mean just turning to a chief technology officer or to information technology staff. Jerry Crisci, director of technology in Scarsdale, New York, explains the risk of just trusting the tech experts alone for this type of redesign: "[T]hings can be driven by the technical needs of the system and not instructional needs." For instance, he notes, "There are some schools that block Google Earth because the IT staff says it is constantly loading data on the map and is going to bring down the network. . . . They're looking at it from a technical standpoint rather than asking, 'How can we use this tool in the classroom?'" He says, "More often than not, when the IT people are running the show, there is less emphasis on instruction than on making sure everything is locked down."

If it's not just turning to the IT team, how can school or district leaders find learning engineers? Keep your eyes open and look around—both inside and outside your school system. One of us works closely with a colleague who spent more than a decade in universities doing controlled trials on instructional design, before moving industries to apply those same principles to corporate training programs.

So such candidates may not be working in schools, or even in a K–12 environment—they might be working at universities, or in workplace training. With the right learning engineering approach, it won't matter—the challenges are similar across a wide range of ages and tasks. (That said, it's indisputable that those designing learning for the littlest students benefit from specialized understanding about their learning, just as pediatric medicine draws on but has essential differences from adult medicine.)

It's an advantage for a learning engineer to have studied cognitive science or learning science, but they really only need to be intellectually agile, able, and willing to read research and ready to try to make sense of the ongoing work at the intersection of cognitive science, "big data," technology, and student learning. Indeed, there are new programs that will take people with instructional design experience and give them a learning science foundation, like the master's degree in Learning Science and Engineering starting up at Carnegie Mellon University in 2013, or the internal training program within Kaplan, Inc., that is meant to give "learning architects" the requisite background in evidence-based instructional design.[5]

OK, so you've got your learning engineer, but you're not exactly sure what to ask her to do or how to tap her talents. Well, here are three easy places to start. If you lean on a learning engineer to help steer just these three things, we think the rest will start to follow more naturally.

Ask how solutions tap learning science: When their wares aren't selling, vendors and developers can be tempted to latch on to cosmetic changes to their offerings or in the marketing materials. This is easier and less disruptive than actually solving the problem. However, if pressed to explain the evidence that these offerings work as intended, providers will have little recourse but to start pursuing more fundamental fixes. This means it's on school and system leaders to ask these hard questions, and demand no-nonsense responses.

Employ smart pilots: When deciding how to employ promising technologies, leaders and their learning engineers should seek to pilot them in a disciplined way. This is tough. It requires a cultural shift, especially in systems where teachers guard themselves against waves of half-baked reforms and faddish new learning approaches. Indeed, too often, interventions are designed with insufficient attention to the rollout, so that teachers have to figure out what the developers should have thought through. Well-designed pilots that include training, monitoring, and coaching of teachers and are linked to good measures of implementation and outcomes can help determine what works and how it can work better.

There's strength in numbers: Scale makes a difference. If learning engineers across many schools or systems collaborate, they can push providers to respond. (Note how energetically publishers and developers have responded to the Common Core State Standards.) Banding together to share data and coordinate pilots can allow participants to learn more quickly which interventions work for which kids. Collaboration enables "research and development" networks that can attract top-shelf research partners, vendors eager to design user-friendly solutions, and funding from foundations and federal research agencies. The federally supported League of Innovative Schools is one such network, but there's plenty of room for more in a nation with 50 million K–12 students.[6]

LEARNING ENGINEERS RIDE IN THE ENGINE, NOT THE CABOOSE

A common frustration among educational leaders is the sense that online learning and virtual schooling are something being done *to* them by policymakers, their supervisors, and would-be reformers. In our experience, plenty of principals and superintendents feel that they're adopting technology under duress—that the state is requiring them to ensure that high schoolers take at least one online course, and so they've got to make that happen, regardless of readiness or know-how. In other cases, school leaders feel pressed to incorporate virtual school options or to adopt new devices—while remaining unsure how to do it or about the possible benefits for kids.

This is a common challenge. Fortunately, thinking like a learning engineer helps you turn these sorts of mandates into fuel for success.

First, if you regard these dictates as an opportunity rather than a burden, they can be the spark that prompts a reluctant school community to embrace the possibilities implicit in new tools. Once the rethinking begins, a creative learning engineer can help guide the thinking along lines that lead to solving learning problems and not just checking the boxes. Don't settle for layering new technology atop old routines and hoping for the best. Thinking like a learning engineer offers a more fruitful path forward.

Second, thinking like a learning engineer can help you get ahead of these kinds of ongoing mandates. The thing is, many would-be reformers have grown so frustrated with slow-footed or clumsy leadership that they've embraced heavy-handed proposals from above just to get schools and districts moving. School and system leaders are well-acquainted with the results—and they're often not pretty. Consider the case of No Child Left Behind. Though NCLB has some real virtues, including raising the visibility of disparities in student performance, its crude measures of Adequate Yearly Progress and teacher quality and its one-size-fits-all requirements and remedies have drawn the ire of many a school and system leader.

So why did policymakers write such a ham-handed law? Part of the problem was that Congress had come to regard the education community with some suspicion on academic progress prior to 2001. After their fierce opposition to even the modest voluntary testing proposed by President Bill Clinton in the 1994 reauthorization of the Elementary and Secondary Education Act, educators were viewed as naysayers and footdraggers unwilling to help craft workable accountability systems.[7] Leaders would have had a much more prominent place at the table if they were seen as credible, constructive problem solvers.

Foundations, advocacy groups, and policymakers are eager to identify and support savvy, hard-charging leaders and dynamic learning engineers. That's why leaders like Rick Ogston, Mark Edwards, John Danner, and Diane Tavenner are sought out for advice and wooed by foundations. The truth is that legislators, supervisors, and advocates are eager to work with and listen to those they view as no-excuses, practical problem solvers. By showing that schooling can be refashioned by savvy practitioners, learning engineers can temper the sense that external reformers need to "fix" schools through meat-cleaver political policy dictates that can't possibly address the constraints and opportunities that districts face.

Here's the thing. If you, as a learning engineer, turn clumsy mandates into opportunities for smart problem solving, you're doing more than making lemons into lemonade. You're also gaining credibility, making it more likely you'll be consulted or at least get a hearing the next time someone floats a bright idea, and whether it's good or bad, your view of it will be valued. You'll be earning the personal capital that will let you suggest ways to improve current policy without being dismissed as a naysayer.

REVISITING OUR MYTHS

Back in Chapter 1, we observed that educators, parents, policymakers, and the general public can get confused by or caught up in any number of myths when it comes to schools and technology. Some promise that learning engineering is unnecessary if educators will just drink the Kool-Aid and embrace the wonders of the "digital revolution." Others suggest that technology is somehow worrisome or a threat to educators. Let's take a moment to revisit each of these.

Today's kids are different because they are digital natives. What a kid brings to class in long-term memory today (a dazzling ability to type on teeny keyboards, for example) is different from what their parents brought 35 years ago, but the learning challenge isn't. The challenge is still how to help students develop mastery of new knowledge, concepts, and skills. Today's students may enter school with new things in their long-term memory, but the fact that learning requires deliberate practice that allows working memory to build fluent mastery in long-term memory remains constant. Whether students are adept with smartphones or not, mastery is still aided by well-structured information, demonstrations, deliberate practice, prompt feedback, and motivational support.

More technology yields more learning. This is silly. Sixty years ago, did having an extra 100 ballpoint pens on hand mean that students learned more? A generation ago, did having more televisions on campus yield more learning (beyond the plot of *Days of Our Lives*)? What matters is whether technology is used to enhance and enrich the key elements of learning—outcomes, assessments, practice and feedback, demonstrations, information, overviews, and motivation. Technology can help with this, while making learning more affordable, reliable, available, customizable, and data-rich, but it has to be *designed* accordingly.

Adding technology is "anti-teacher." Technology is not anti-teacher or pro-teacher, any more than buying your auto mechanic a new wrench means you're "anti-mechanic." Technology makes it possible to automate routine tasks, for professionals to spend less time on administrative trivia, and to provide new supports and tools. However, its biggest impact is in magnifying and extending the impact of terrific teaching. Using technology to liberate talent from rote and unproductive tasks is a crucial element of good design. How that plays out in staffing and job descriptions is an open question and is a conversation that educators should embrace and help guide rather than fear.

Virtual schools are "different" from brick-and-mortar schools, and that's a problem. If a virtual school is poorly designed, that's a big problem. But there's no reason to assume that a virtual school is inherently any worse than a brick-and-mortar school. Virtual schools simply pose different constraints (less face-to-face interaction with cheerful peers and caring teachers) and opportunities (less face-to-face interaction with hostile peers and disinterested teachers). A given student may suffer without traditional interaction with peers or in-person time with a teacher; another student may benefit from more customization, a greater variety of course options, and the chance to move at her own pace. Blanket judgments are less useful than an examination of how schools meet the learning needs of their students.

There's "not enough" technology to drive transformation. Sometimes, a leader will explain that learning technology hasn't mattered yet but will once they have enough devices to permit a one-to-one model. Color us doubtful. From a learning engineer's perspective, this makes no sense. Going to one-to-one computing doesn't mean learning will occur—it can provide a solid platform for terrible learning solutions or for good ones. What matters is how learning activities change, how the data flow, or what students do differently to draw on long-term memory for working memory challenges. There might not be enough technology—or there might be too much, consuming too many resources (cash and distracted eyeballs) that would be better directed elsewhere.

The next generation of technology will make things different. There's no particular reason that a student's learning will improve merely because cool, new devices emerge. Heck, we've been hearing this one since the 1980s, and it hasn't happened yet. If you know what you're doing with current technology, then new and improved versions will probably help. But if you don't know what you're doing with today's technology, it's a mistake to put too much faith in the miraculous power of tomorrow's—whatever the Silicon Valley marketing brochures say.

Learning doesn't always work the way we wish it did. Learning is defined by how minds actually work, and that's what learning science can help explain. Nothing we've just said cools our ardor about the potential of technology to profoundly improve teaching and learning. But the next time you hear these familiar myths, just be sure to push past the talking points and focus on what matters.

THE BAD NEWS . . . IS THE GOOD NEWS

Given the pace of change, how can educators keep up and make the right decisions about technology? Fortunately, things are made easier for educators because the way learning works is connected to how our brains are wired. And our brains change a whole lot more slowly than technology.

We closed Chapter 1 by comparing education technology to a rushing river filled with shiny (dare we say sometimes “fishy”) ideas. An engineer doesn’t just wade in and start grabbing. The engineer thinks it through, erects a bridge from which to survey the river, and baits his hook deliberately. When it comes to schooling, that bridge is learning science. That bridge permits educators to survey the glittering, eye-catching ideas that flash beneath, and choose deliberately. If it’s not clear how a given idea will improve teaching and learning, let it pass. If it looks promising, fish it out. You may throw it back, but it’s worth a look. All the while, you’re not splashing around but are coolly assessing possible solutions with an eye to what matters.

As learning science and technology advance, new possibilities will keep emerging, creating new opportunities to support great teaching and learning. Leaders who possess an understanding of learning science and who have cultivated the ability to diagnose and rethink learning problems will be equipped to leverage new tools, seek smarter solutions, and transform schooling to reliably improve learning over time.

In the end, as we said at the outset, the good news and bad news for digital learning is the same: The solutions with the most evidence haven’t been applied yet. The bad news is that this means that learners and teachers aren’t benefiting. But the good news is that all these important, well-supported ideas are just waiting to be used.

The United States is a hotbed of innovation across many industries—and nations like China, India, and Japan study our schools as assiduously as we study theirs. Indeed, with the right kind of support and rethinking, the American educational system has enormous advantages when it comes to learning engineering: increasingly sophisticated and coordinated assessment and data systems, decentralized authority leading to multiple lines of innovation, and our historic openness to new ideas and new solutions.

It will require a degree of thoughtful discipline that's often absent, if all this effort is to amount to more than fresh waves of faddism. When it comes to education technology, we'd do well to cease being quite so starry-eyed, especially as we resist the tendency to simply stick with familiar routines. It can be hard to find that sweet spot, especially in a profession that's inevitably whipsawed by moral urgency and frustrating bureaucracies. And that's where learning science can help. Indeed, what Carpe Diem, Mooresville, Rocketship, or Summit teach is that learning engineers can triumph whatever the circumstances and challenges.

The work is doable, and it's essential. It's time to get on with it.

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