

# **DISRUPTING CLASS**

How Disruptive Innovation Will  
Change the Way the World Learns

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# Introduction

We have high hopes for our schools. While each of us might articulate these hopes differently, four seem common to many of us. We summarize these aspirations as:

1. Maximize human potential.
2. Facilitate a vibrant, participative democracy in which we have an informed electorate that is capable of not being “spun” by self-interested leaders.
3. Hone the skills, capabilities, and attitudes that will help our economy remain prosperous and economically competitive.
4. Nurture the understanding that people can see things differently—and that those differences merit respect rather than persecution.<sup>1</sup>

We’re not doing very well in the journey toward these aspirations. Weakening churches and families must shoulder their share of the blame for our back-sliding and wheel-spinning. But most of us wish schools were playing a much more effective role in our efforts to move society toward goals like these.

Why do schools struggle to improve? Everyone has a theory. One is that *schools are underfunded*. If this is the problem, the answer must be more state appropriations, higher local property taxes, and additional fees from parents. Civil rights groups file lawsuits claiming that states that deny schools adequate funding are ignoring their constitutional obligations. And a 2006 Gallup poll suggests that the public favors higher compensation for teachers.

But is money the cause or the cure? The U.S. public education system spends more per student than all but a few countries, and yet, on average, its students often perform at or below the level of those in other economically advanced countries. Over the past three decades, real spending per student has doubled without a commensurate gain in achievement. And across school districts, spending per student does not necessarily track performance. Just compare two schools in Kentucky: In 2004, Portland Elementary School in Jefferson County spent three times as much per pupil as did Carlisle County Elementary School. Yet Carlisle County, which has a similar demographic makeup to Portland,<sup>2</sup> scored 26 percent better on the state accountability index. This is not to say that money does not matter. But if money or the lack of it by itself explained why the struggles persist, we would not see the anomalies across nations, within Kentucky, or, indeed, across many other districts in the United States. Other forces must also be in play.

Perhaps there's a problem because there *aren't enough computers in the classroom*.<sup>3</sup> When the push to add computers in classrooms started in the mid-1980s, this now-common tool of work and play was just beginning to penetrate every sector of society. Many people predicted that computers would revolutionize the world, and they viewed not having computers in schools as an injustice.

Similar to spending overall, spending on computers in schools has increased dramatically. By 1995, the average public school in the United States had 72 computers available to support instruction. By 2003, this average had nearly doubled to 136.

And whereas in 1998 there was an average of 12 students for every computer with Internet access, by 2003, that number was down to nearly 4. If the addition of computers to classrooms were a cure, there would be evidence of it by now. There is not. Test scores have barely budged. There must be a better explanation than more computers and technology.

Another camp *blames the students and their parents*. Educators often complain about students who are uninterested and not ready to learn; or parents who do not monitor homework or show up for conferences. This argument resonates with the public. They see kids on street corners with their hats in a backwards pose and their trousers dragging and droopy. Indeed, just to exacerbate the problem facing schools, the number of students from minority backgrounds who have historically performed least well in U.S. schools has skyrocketed in recent years, from just over 20 percent in the 1970s to around 35 percent today. And the population of those who do not speak English at home, a population that has also underperformed historically, has also climbed, from just under 10 percent before 1980 to around 20 percent today.<sup>4</sup>

These factors certainly make a school's job harder. But there are anomalies to this generalized explanation that suggest that this is not the root cause of schools' struggles, either. Many schools where these "least promising" children dominate the enrollment have comparable results to schools with more affluent populations. Take the example of Montgomery County Public Schools in Maryland, which has divided its schools into two categories: red-zone schools, which are those highly affected by poverty, and green-zone schools, which are not. Ever since the district identified the red-zone schools and began treating them differently from their green-zone counterparts, performance by minority students in the red-zone schools has soared to the point where it now approaches that of the predominately white students in green-zone schools.<sup>5</sup> Furthermore, the entering quality of students tells us nothing about how the schools themselves are operating once the

students are in the classroom. There has to be a better explanation than simply blaming the students.

Could it be that the *U.S. teaching model is simply broken compared to other models in other countries?* Picture a school where in every classroom, the teacher stands at the front of the room and lectures all day at the students. The students never speak, and even if they do not understand a concept, they never ask for help. The teacher just keeps lecturing. Exams test rote memorization. Now contrast this with a class where the teaching methods are more varied and the environment more energetic. Yes, the teacher lectures, but students frequently raise their hands to participate in discussions. Other times students do work while the teacher walks around and offers a helping hand. And still at other times, students work on fun projects in groups.

Which school is better? Most say the latter one is. What is interesting, however, is that the former school is representative of the traditional classroom model in much of Asia while the latter more typifies the U.S. style.<sup>6</sup> Based on this, we would expect the students from Asian classrooms to perform more poorly than those in the United States. But, on average, the Asian students actually score far higher on math assessments than the U.S. students do. Paradoxically, many of these Asian schools have been adopting many of the U.S. schools' practices. So there must be a better explanation than a broken teaching model.

Then the *teachers unions must be the problem.* Many make the argument that unions force school districts to put a higher priority on the needs of the professionals working in the system than on the students' needs. If we could free the schools from the unions' stranglehold, the logic goes, the schools would better serve their students.

Like all explanations, this may be true to a degree, but as the definitive explanation, it does not hold up. The Montgomery County Public Schools district, for example, has a strong teachers union, whereas the Charleston County, South

Carolina, district has no teachers union. And yet, students in Montgomery County Public Schools outperform those from Charleston.<sup>7</sup> Indeed, some chartered\* schools in the United States, which are free from the constraints of teachers unions, perform no better—and sometimes perform even worse—than the unionized schools. So solving the union problem may not solve the schools’ problem.

So if too little money, too few computers, uninterested or unprepared students (and parents), a broken teaching paradigm, and strong unions individually are not the root cause of the U.S. public schools’ struggles, might it be that *they all are conspiring collectively to constrain the United States?* Of course. But all these issues are at work in other nations’ schools as well—and yet the evidence is that many of them obtain better results than do those in the United States.

As the evidence discredits the common explanations for the educational struggles one by one, another accounting has more recently emerged: *The way we measure schools’ performance is fundamentally flawed.* This, of course, is also true. Even the best measures are an approximation of the underlying reality—for every country’s schools.<sup>8</sup>

But consider this observation, which goes beyond the hotly contested validity of test scores. One of the authors of this book, Clayton Christensen, has frequented Silicon Valley’s corridors and cubicles for much of his professional life. Thirty years ago, people born and educated in the United States largely occupied those workspaces. Today, a stunning proportion of the people

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\* In this book we use the term “chartered schools” rather than the commonly used term “charter schools.” We are referring to the same phenomenon, but we use the different language in reaction to the fallacy of the common expression, which expresses as a compound noun what is an adjective and a noun. Calling a school a “charter school” implies a typology that does not exist. The notion of charter refers only to the manner in which a new school was created. Indeed, schools that were created through charters today reflect a rather full range of typologies—some are quite traditional in their practices, while others are organized around student projects or are virtual schools with no physical structure. So while it will strike some as odd, we prefer the word “chartered” because it is a more accurate characterization of the shift in public policy that began in the early 1990s.

in these offices and cubicles are Israeli, Indian, and Chinese. Those educated in U.S. schools are losing share—and it's not because the United States is uniquely unable to measure true academic achievement. The United States has kept its technological edge in the world not because its public schools are sending the best potential technologists to U.S. colleges. The United States is clinging to its advantage because it has continued to be a magnet for the best talent in the world. But this, too, has begun to change.<sup>9</sup>

If the common explanations do not explain the problem, what is the reason for the educational woes?

## ❖ THE CAUSES OF EDUCATIONAL MALAISE

The purpose of this book is to dig beneath the sorts of surface explanations summarized above to expose more fundamental root causes for why schools struggle to improve. Upon that basic foundation we then construct a set of recommendations to resolve those problems. Our methods for reaching these conclusions are unique. Most books on the topic of improving schools have reached their conclusions by studying schools. In contrast, our field of scholarship is innovation. Our approach in researching and writing this book has been to stand *outside* the public education industry and put our innovation research on almost like a set of lenses to examine the industry's problems from this different perspective. The ability of these lenses to shed new light on complicated problems has been proven in contexts ranging from national defense to semiconductors; from health care to retailing; and from automobiles to financial services to telecommunications. We hope that this novel approach to the problems of public education will prove to have yielded comparably innovative insights.

So let's diagnose the fundamental problem. If other countries have these same factors at work in their schools, why is it that so many of their students outperform U.S. students?

Motivation is the catalyzing ingredient for every successful innovation. The same is true for learning. We all know that becoming a great athlete or a great pianist requires an extraordinary amount of consistent work. The hours of time required to train the brain to fire the synapses in the correct ways and thus hone the necessary muscle memory and thinking required is no different from that needed to learn to read and process information or think through math and science problems. Unless students (and teachers, for that matter) are motivated, they will reject the rigor of any learning task and abandon it before achieving success.

Motivation can be extrinsic and intrinsic. *Extrinsic motivation* is that which comes from outside the task. For example, a person might learn to do something not because she found the task itself stimulating or interesting, but because learning it would give her access to something else she wanted. *Intrinsic motivation* is when the work itself stimulates and compels an individual to stay with the task because the task by itself is inherently fun and enjoyable. In this situation, were there no outside pressures, an intrinsically motivated person might still very well decide to tackle this work.<sup>10</sup>

When there is high extrinsic motivation for someone to learn something, schools' jobs are easier. They do not have to teach material in an intrinsically motivating way because simply offering the material is enough. Students will choose to master it because of the extrinsic pressure. When there is no extrinsic motivation, however, things become trickier. Schools need to create intrinsically engaging methods for learning.

Consider this example. When Japanese companies were developing their world-class manufacturing clout and passing American companies in the 1970s and 1980s, a common explanation was that four times as many Japanese college students were studying math, science, and engineering than were U.S. students—despite the fact that Japan had only 40 percent of the population of the United States. These scientists and engineers, many con-

cluded, were responsible for Japan's economic ascendancy, which was widely seen as a threat to the U.S. economy.<sup>11</sup>

As Japan reached prosperity, an interesting thing happened, however. The percentage of students who graduated with science and engineering degrees declined. Why did this happen? The answer has little to do with the schools themselves, which did not change significantly. Prosperity was the culprit. When Japan was emerging from the ashes of World War II, there was a clear extrinsic motivation that encouraged students to study subjects like science and engineering that would help lift them out of poverty and reward them with a generous wage. As the country and its families prospered, however, the external pressure diminished. Some people who are wired to enjoy science and engineering in the way schools traditionally teach it—and therefore are intrinsically motivated—or those who have other extrinsic motivations in play still study them. But many no longer need to endure studying subjects that are not fun for them. The same downward trend is now beginning in Singapore and Korea. As their economies have prospered, a smaller portion of their students are studying math and engineering because the extrinsic motivation has disappeared—and there is precious little intrinsic motivation, given the way these subjects are taught.

Let's take one more example. As we said earlier, one of the authors of this book, Clayton Christensen, knows many of the "founders" of Silicon Valley well. These men and women are world-class engineers, mathematicians, and scientists. Few of the children of these titans, however, have studied these subjects. Instead, they've chosen fields in the humanities and social sciences. With prosperity in the family, one extrinsic motivation to study these subjects is gone. As the U.S. president John Adams famously said:

*I must study politics and war that my sons may have liberty to study mathematics and philosophy. My sons ought to study mathematics and philosophy, geography, natural history, naval architecture, navigation, commerce, and*

*agriculture in order to give their children a right to study painting, poetry, music, architecture, statuary, tapestry, and porcelain.*

Adams was on to something. As a developing country develops an industrial-based economy, studying science, math, and engineering offer big rewards that ensure students an escape from poverty. When the same country achieves stability and prosperity, students have more freedom to study subjects that they find fun and intrinsically motivating.

Oddly, therefore, prosperity can be an enemy to motivation to study topics that are not taught in intrinsically motivating ways.<sup>12</sup> This is a key reason why technological advantage shifted first to Japan and is now shifting to China and India. Because of a variety of cultural, economic, and societal factors, the United States' schools start from a disadvantage compared to many of their international counterparts, where there is far more extrinsic motivation present in society. We also note that in many developing countries studying hard and mastering science and engineering in school does not necessarily result in prosperity—at least not yet. In those countries there isn't much of an extrinsic reason to endure school either.<sup>13</sup>

Prosperity isn't the only factor, of course. There are many lower-income students in prosperous societies who are unmotivated because there are complicated cultural and familial influences at work as well. The famous Coleman report (1966), made this argument. It asserted that family background was the factor of greatest importance in determining how a student performed in school in the United States and concluded that schools cannot be expected to carry society toward the objectives we listed at the outset of the chapter. Nonetheless, schools must be a significant, positive force in this direction; they can certainly improve.<sup>14</sup>

Schooling can and should be an intrinsically motivating experience. The questions are why this often has not been the case, and how to resolve these problems. Explaining *why* and *how* is the purpose of this book.

## ❖ SOURCES OF SCHOOLS' STRUGGLES

The following chapters summarize what we have seen by standing outside the public education industry and examining it through the lenses of the theories of disruptive innovation. These theories have emerged from two decades of research. These are theories whose applicability is not limited to specific industries or to for-profit enterprises only. As you'll see in the following chapters, they shed considerable light on the challenge of making learning intrinsically motivating for each student. From this diagnosis of the root causes, a promising path emerges that offers a way forward for educators from around the world to ensure that each individual student learns.

Although the examples in this book are largely from the United States, we believe the lessons apply to contexts around the world. In fact, some of our recommendations already are beginning to be implemented in many developing countries.

While many of the theories on innovation have emerged from our own research, we are indebted to many other scholars and practitioners for much of what follows. Here is a chapter-by-chapter preview of the book:

*Chapter 1:* Every student learns in a different way. This idea—that students have different learning needs—is one of the cornerstones of this book. A key step toward making school intrinsically motivating is to customize an education to match the way each child best learns. As we explain in this first chapter, schools' interdependent architectures force them to standardize the way they teach and test. Standardization clashes with the need for customization in learning. To introduce customization, schools need to move away from the monolithic instruction of batches of students toward a modular, student-centric approach using software as an important delivery vehicle.

*Chapter 2:* What gives us confidence that schools are able to make the shift to a student-centric approach? A primer on the theory of disruptive innovation reveals that schools in the

United States have in fact constantly improved. Society just keeps moving the goalposts on schools by changing the definition of quality and asking schools to take on new jobs. Even in these new landscapes, where most successful organizations fail, schools have adapted remarkably well.

If you aren't familiar with the theory of disruptive innovation, Chapter 2 will prove helpful to understanding the rest of the book. Disruption is a positive force. It is the process by which an innovation transforms a market whose services or products are complicated and expensive into one where simplicity, convenience, accessibility, and affordability characterize the industry.

*Chapter 3:* Given the present interdependent curricular architecture of most schools, what might allow them to migrate to a more modular, student-centric approach? Technology presents a promising path. We broadly define technology as the processes by which an organization transforms inputs of labor, capital, materials, and information into products and services of greater value. Hence, all firms, including schools, employ a range of technologies. Some of these are *student-centric technologies* that can mediate the clash caused by the need to standardize the way schools teach and test versus the need to customize how students learn. In its most common manifestation, student-centric technology comprises a computer with software, which can tailor itself to a student's specific type of intelligence or learning style. An individual tutor would be another type of student-centric technology. *Monolithic technology*, in contrast, employs a single instructional style for all students. A teacher lecturing a classroom of students, all of whom use the same textbook, is the most common monolithic technology in education. But computers whose software tries to teach all students in the same way would also be a monolithic technology.

The question is: why haven't schools been able to march down this path? After all, they have spent upwards of \$60 billion over

the last two decades placing computers in schools. The answer is that schools have done what all organizations are inclined to do when instituting a new technology. They have “crammed” the new technologies into their existing structure, rather than allowing the disruptive technology to take root in a new model and allow that to grow and change how they operate.

*Chapter 4:* How then can schools successfully implement computer-based learning? The key is to let it compete against non-consumption at the outset, where the alternative to taking a class from the computer is nothing at all. We explain what this means in this chapter, as well as offer examples of how schools are already doing this and how they might do it even more successfully.

*Chapter 5:* Disruption is a two-stage process. We show in Chapter 4 that schools are already implementing computer-based learning. But to move to full student-centric learning, we will need to incubate many of these technologies outside the K-12 public education system. Disruption and student-centric technology must first solve important problems outside the traditional classroom before they transform instruction inside it. In so doing, they will, over time, likely fashion an entirely new commercial system in education. We give some educated guesses in this chapter at what this might look like.

*Chapter 6:* The first five chapters form an interdependent argument about how to migrate from monolithic methods of instruction to student-centric technologies in the K-12 years—something we believe is crucial to enable children to realize their highest potential. There is an overwhelming body of evidence, however, that starting at age 5 in kindergarten is much too late. Indeed, our experiences in the first 18 months of life largely shape our intellectual capacities. And much of the self-confidence that buoys us up or bogs us down through the rest of our lives is essentially in place by age 5. Addressing these issues is itself a book-length project, but as the movement

to expand to universal pre-K grows, it's something important to address. In Chapter 6, we take a 10,000-foot view of these challenges and evaluate the possible efficacy of certain solutions that have been proposed.

*Chapter 7:* Here we explain why the standard research approach in collegiate schools of education has not provided clear guidance to educators. This chapter suggests a way forward for education research in the field to improve predictability in education.

*Chapter 8:* As we progress toward student-centric technology, there are many other managerial and organizational challenges along the way. Many of these are pressing concerns for educators today. In this chapter and in Chapter 9, we apply theories from our research to offer a managerial toolkit to school leaders and policymakers as an aid in implementing these changes.

The world of education is one in which there is little agreement on what the goals are, let alone the methods that are best-suited to achieve them. In this environment, only certain tools will work to introduce change. Issues must be addressed in a circumstance-based way. Types of tools that can be employed are discussed in this chapter. School leaders must make far more use of the “tools of power and separation.” We explain why this is and what it means in this chapter.

*Chapter 9:* Because school leaders are limited in the tools they can use effectively, this has implications for how they introduce change. Too often U.S. schools have struggled because they try implementing architectural-level reforms within teams that are inappropriate for these sorts of changes. In this chapter, we explain what types of teams are appropriate for what types of problems and give recommendations for a new way to visualize the role chartered schools can play in the U.S. education system.

The road to realizing our highest hopes for our schools is not an easy one. But with breakthroughs occurring every day in understanding how children learn and how they build intellectual capacity, there is a great opportunity to make strides in the years ahead, provided we do so with an understanding of the root causes of why schools have struggled so much. If we embark upon the promising path we outline in this book, we can make schooling intrinsically motivating and help our children maximize their individual potential to realize their most daring dreams.

To start us down this path, we begin with a fictional story set in a struggling high school in California. This opening vignette introduces us to the central characters in a story that runs through the book at the beginning of each chapter.

## NOTES

1. We thank our friend Dennis Hunter for helping us articulate these widely shared goals. Over the past few years of researching this book, many people have expressed high hopes for our schools to us. Our list here is certainly not collectively exhaustive or a scientific approach to capturing these aspirations, but it represents an attempt by us to capture the spirit and intent for what many of us hope our schools will help those in the next generation attain.
2. Like Portland, over 50 percent of Carlisle's students are on free/reduced lunch.
3. While most educators have moved beyond making this argument after seeing its limitations, many politicians and pundits still put forth this point, and many polls capture the feeling from the public that investment in computers is vital for a school. Indeed, as we will suggest in this book, computers can play an important part in helping our schools improve, but it matters far more how they are used and implemented than just the mere addition of them.
4. "Elementary/Secondary Education: Table 5-1" *Participation in Education*, National Center for Education Statistics, <http://nces.ed.gov/programs/coe/2007/section1/table.asp?tableID=667>. "Elementary/Secondary Education: Table 6-1" *Participation in Education*, National Center for Education Statistics, <http://nces.ed.gov/programs/coe/2007/section1/table.asp?tableID=668>.
5. For example, the percentage of African-American and Hispanic kindergartners in the red zone reading at or above the end-of-year reading

- benchmark now nearly matches that of white students in the green zone, up from a significant gap just five years ago. Montgomery County Public Schools presentation, Harvard Public Education Leadership Conference, June 20, 2007.
6. Michael Alison Chandler, "Asian Educators Looking to Loudoun for an Edge," *The Washington Post*, Monday, March 19, 2001, p. B01. Also from Clayton M. Christensen firsthand observations.
  7. We understand that private school enrollment ratios factor in here. They are quite high in Charleston among white students, although this plays into the "bad-student argument." Still, the anomalies show that the existence of teachers unions cannot be argued as the crucial pivot point for the success of schools.
  8. To some extent all countries face the same problems the United States does. First, no country has universally agreed upon the magic all-encompassing "purpose of education"; while the United States frets over low test scores, the Japanese wonder if their rote learning teaching style stifles creativity. Maybe U.S. students' willingness to question authority and ask "why" is a positive that tests just do not capture. Second, no nation has been able to satisfactorily educate each and every one of its citizens.
  9. An article in *The Economist* adds weight to this observation. "America's high-tech industries are powered by foreign brains," it notes. "Almost a third of Silicon Valley start-ups since 1995 were founded by Indians or Chinese. They also power great U.S. universities, particularly the science departments. About 40 percent of people earning Ph.D.s in computer science and engineering are foreign-born." But as we note, America's attraction to foreign-born talent is waning. *The Economist's* article talks about how U.S. immigration laws create long waiting times for talented workers to enter the country and, consequently, turn them off. Furthermore, other countries—"including Australia, Canada, Britain, Germany, and even France"—are clamoring for this talent. "At the same time the Indian and Chinese economies are booming. . . . Indians and Chinese were once willing to put up with any humiliation for a chance of a career in the United States. Now they have more and more choices back home." "American Idiocracy: Why the Immigration System Needs Urgent Fixing," *The Economist*, March 24–30, 2007, p. 40.
  10. To capture what social scientists call the "discretionary effort" of students, people are giving more attention to the sources of motivation. Mihaly Csikszentmihalyi, a psychology professor at Claremont Graduate University and a leading proponent of positive psychology, is best known for writing about the "flow." In an interview with *Wired* magazine for its September 2006 issue, Csikszentmihalyi described "flow" as "being completely involved in an activity for its own sake. The ego falls away. Time flies. Every action, movement, and thought follows inevitably from the previous one, like

playing jazz. Your whole being is involved, and you're using your skills to the utmost." This concept is another way of thinking about intrinsic motivation. See "Go With the Flow," *Wired*, September 2006, Issue 4.09.

11. C. M. Christensen, T. Craig, and S. Hart, "The Great Disruption," *Foreign Affairs*, vol. 80, March/April 2001, pp. 80–95.
12. In a report, parents and students note that they don't see the relevance of these higher-level topics and skills for their own lives. Public Agenda, which produced the report, noted that this mirrored national results. Interestingly, parents and students were more motivated to push for these subjects if it would benefit them in the college application process. See Alison Kadlec and Will Friedman with Amber Ott, *Important, But Not for Me: Parents and Students in Kansas and Missouri Talk about Math, Science, and Technology Education*, Public Agenda, 2007. Summarized in Meris Stansbury, "Parents, Kids Don't See Need for Math, Science Skills," *eSchool News*, September 21, 2007.

There are more cards stacked against producing more U.S. scientists, according to several reports. A *Chronicle of Higher Education* article cites evidence that the "long periods of training, a shortage of academic jobs, and intense competition for research grants" cause many of America's brightest students to bypass careers in science. More and more Ph.D.s enter into temporary postdoctoral positions, as opposed to full-time jobs, and therefore their job security and economic futures are uncertain. Many undergraduates see the problem early and opt out of the sciences while they're still in college. Others jump ship for other opportunities in commercial fields. Richard Monastersky, "The Real Science Crisis: Bleak Prospects for Young Researchers," *The Chronicle of Higher Education*, September 21, 2007.

As another article says, "Many qualified Americans shun science because, far more than the drum beaters let on, science can be a risky, unrewarding career choice. When it comes to agricultural picking and stooping, our foreign reliance is easily understood even without a rudimentary grasp of economics: The pay and working conditions are so miserable that only impoverished foreigners see the chance of a step up. . . . The reliance on foreigners to fill U.S. science classrooms and staff labs and science and engineering faculties is similarly clear." He goes on to detail the career choice for someone thinking about law school with its \$100,000 salary in three years or a Ph.D. with its pay of \$40,000—maybe—in five to seven years. "For the many young foreign students from developing countries who seek promising careers, science in America is extremely attractive compared to the choices back home." Dan Greenberg, "No Mystery Why Americans Shun Science Careers," *The Chronicle of Higher Education*, December 17, 2007.

13. In a study in Usenge, Kenya, researchers tested children's ability to adapt to their indigenous environment. What they found was that students had great knowledge of how to survive in their climate—how to recognize

and overcome parasitic illnesses, for example. Children's scores on tests to measure this were inversely correlated with tests that measured more academic knowledge, such as that taught in schools. They did well in the former and poorly in the latter. In Robert Sternberg's words, "From the standpoint of an academic test, the rural Kenyan children would not look very bright. But in fact, they have learned knowledge that was important in their own cultural context. . . . To these children in rural Kenya, however, the intelligence needed for survival and success in life, in general, may not be the same as the intelligence needed for success in school, and the former may be more important to them than the latter." In other words, the children would learn what they had an outside motivation and need to learn because it was more relevant to their immediate lives. Robert J. Sternberg, "Who Are the Bright Children? The Cultural Context of Being and Acting Intelligent," *Educational Researcher*, vol. 36, no. 3, pp. 149–150.

14. There is a long-running debate on this. For one side of it, see Richard Rothstein's *Class and Schools*, which makes the argument that schools can't fix these problems alone. The country needs policy changes in health care, improvements in early childhood care/education, and so on. A book by Abigail and Stephan Thernstrom titled, *No Excuses: Closing the Racial Gap in Learning*, takes the other side. It hypothesizes that there are some schools like the Knowledge Is Power Program (KIPP) and others that do not have any excuses—in other words, they don't blame health care or poor parenting—and they do what Rothstein says is impossible and turn really poor students into high achievers. Rothstein addresses this concept specifically in his book with a multifaceted response. First, he says that a few anomalies do not prove anything. He presents research on the KIPP children, who are supposedly the worst-performing and poorest children in the surrounding public schools. He polls teachers from surrounding schools, however, and finds that they are, in fact, sending the children with the highest potential. This and the fact that KIPP forces parents to be involved—just the very fact that they have to apply and sign a contract indicates that they are more invested than the average parent—means that to Rothstein this is not a fair sample. He also cites that KIPP is a middle school, and there is no evidence that its students attend college or succeed in the long run at greater rates. He also cites AVID (Advancement Via Individual Determination) and says that you cannot use it as an example that the Thernstrom argument is possible because children are interviewed and those with the highest potential, despite poor grades, are taken in. See Richard Rothstein, *Class and Schools: Using Social, Economic, and Educational Reform to Close the Black-White Achievement Gap* (New York: Teachers College, Columbia University, 2004). Abigail Thernstrom and Stephan Thernstrom, *No Excuses: Closing the Racial Gap in Learning* (New York: Simon & Schuster, 2003).

# Randall Circle High School

**R**obert James is one of some 2,000 students at Randall Circle High School in southern California. Today, when the school bell rings at 7:15 a.m. to indicate the 10-minute warning for the start of class, the skinny white junior is dawdling in the parking lot. Talking to soccer buddies, he tries to avoid the thought of the chemistry class that awaits him. He kicks at some loose gravel. He'd rather just get to practice. Rob used to be a punctual kid, and he used to like science, but these days, the thought of Mr. Alvera's chemistry class makes him want to run away from the school's bright blue doors.

In fact, it's not just Rob. Most of the soccer players dawdle in the sunshine. Still, conscience pulls him toward the entrance when he spots the stern-faced new principal, Dr. Stephanie Allston, aiming a look in their direction. Rob slouches in past the administrator and dodges eye contact beneath the brim of his Boston Red Sox hat. He's pretty sure that Mr. Alvera is on the verge of reporting him to the administration for his poor performance, and he doesn't know what to do about it. His engineer dad just might flip out if he hears about it. He wonders if he can get his friend and neighbor Maria to work with him during study hall

again. She's twice as helpful as Mr. Alvera anyway, although she seems to be late this morning, too.

Rob thinks Stephanie Allston is watching him, but the grey-suited woman leaning against the blue paint has what she considers bigger problems: she's the new hired gun at a school teetering on the edge of failure, thanks to poor results on state exams. Known for her success at a nearby middle school, she's not worried about Rob being in over his head. Allston's worried that she's in over her own head. She cringes when she thinks about her first encounter with Carlos Alvera, the chemistry teacher who told her, "I teach it. I don't have the resources to do much more, but that's worked for 25 years." If only every student were like Academics Bowl champ Maria Solomon. The petite black junior grins at Allston as she rushes inside just in time for class, her red backpack bouncing under her ponytail of braids. The bell trills, and Allston smiles back at her. Minus Maria, she's got 2,000 problems waiting inside for her. And to think she could have been a lawyer.

# Chapter 1

## Why Schools Struggle to Teach Differently When Each Student Learns Differently

**M**aria slides into her seat two seconds before the bell rings and curses her alarm clock. She's already behind. Class starts practically before the bell rings because Mr. Alvera likes to cram the period full with as much information as possible. Maria glances over the handout waiting on her desk—it's a bullet-point recap of last night's reading, which she digested easily. She shoots a glance over at Rob and mimes the gesture of taking off his hat. Catching her eye, Rob complies before Mr. Alvera has a chance to say anything.

Rob tugs a hand through his mussed dark red hair and pulls out a notebook as the chemistry teacher explains the formula for the thermodynamic behavior of a gas. He tries to focus on the scrawled chalk that says " $pV = nRT$ "—and diligently copies it into his notebook, as though that will change the fact that he doesn't get it. Mr. Alvera has spent some extra time trying to help him out, but there's limited time for that, and Mr. Alvera only seemed able to explain the same concepts in the same ways—just slower and louder. If Rob's grades keep slipping, Mr. Alvera is required to report him. And if that happens before tomorrow night's soccer game, he suspects he'll be riding the bench. But he's got soccer down: he actually feels worse about the fact that after spending last night poring over the textbook, he still doesn't get the concept.

Across the aisle, Maria sits up and raises her hand to ask a question. “Using  $pV = nRT$ , how would I find the density of a gas at standard temperature and pressure?”

Beside her, Rob’s soccer teammate, second-stringer Doug Kim, looks like he’s taking notes. Rob’s heart sinks. Doug plays forward, too. Rob never used to think of himself as stupid, but these days, he suspects, most people at Randall Circle High School think of him as a dumb jock.

Rob’s slumped shoulders in the third row of the classroom do not escape Alvera’s notice, but Alvera has little time during the class period to dwell on one kid. His experience as a teacher has taught him to triage: some students get it, and others don’t. In a school this big, what can he do? He’s already met with Rob several times after class and given it his best shot. In his own school days, he’d been a miserable English student. Even now, Alvera is not a confident writer; yesterday, he’d had another teacher read over his draft of the memo to Stephanie Allston about Rob’s class performance. He didn’t want to give the new principal a bad impression. And he’s not looking forward to talking to Allston about the school’s star soccer forward. But Alvera can’t afford to pay too much special attention to Rob; he likes the kid and admires his willingness to work hard, but Alvera’s got 120 students in his five classes. All he can do is teach the theory as best he can and move on within the time they have. Alvera allows himself a fleeting moment of regret. Despite hours of extra assistance, he can’t get through to Rob. But he knows that Rob isn’t dumb.

And Rob knows he isn’t dumb. He heads home that afternoon after soccer practice pleasantly sweaty from running sprints in the hot fall afternoon. Unusually, though, the exercise hasn’t made him any less frustrated. Maria had been busy during study hall, and Mr. Alvera had another meeting already scheduled after school. Now Rob’s going to have to face down a problem set with no idea how to tackle it.

Rob is still sitting at the kitchen table, head propped in hands, when his father arrives home from work. Rob doesn’t even look up at the sound of the door opening and closing. Flipping through the pages of his textbook to check the answer to a practice problem, he groans.

“What are you working on?” his dad asks. He sets his briefcase down and starts going through a stack of mail.

Rob looks up at his father. Keep getting the problems wrong, or ask his dad? “I don’t understand this thermodynamic gas stuff,” he says after a long pause, “and Maria wasn’t around to help.”

“Let me see,” his father says, and Robert shoves the textbook over to his father, who seems surprisingly undisturbed.

“OK, Rob, this isn’t so bad,” his father says. “Tell you what. Go down to that store that sells the balloons with helium and bring a few back here.”

The tightness in Rob’s chest eases. Soccer game tomorrow night! By the time he has dashed to the corner store and back with a set of balloons, the evening has started to cool, but it’s still in the 90s. His father is waiting for him in the garage.

“Now take one of the balloons and put it in the car and close the door,” his father suggests. Frowning, Rob does as his dad says, and the two loiter in the waning light until a bang makes Rob jump. His father laughs.

“It’s the balloon! OK, now, I want you to think about the effect of temperature on pressure,” his father says, “and think about how that expands volume beyond the breaking point of the balloon’s rubber . . .”

Rob grins. He’s starting to get it.



Rob struggled in chemistry class because his brain is not wired like his teacher’s or Maria’s. It’s not that Rob is not smart. He mastered the chemistry concept when the teaching was customized to the way he learns. So why can’t schools customize their teaching? As we’ll show, schools have a very interdependent architecture, which mandates standardization. So how do we get customized learning for each student? Modularity allows for customization, so the solution is to move to a modular architecture in schools. Only then can Rob have a learning solution customized to how he learns.

Most of us intuitively know that we all learn differently from each other—through different methods, with different styles, and at different paces. We remember not being able to pick up a concept at the same time someone else grasped it instinc-

tively. And we remember that occasionally a teacher or parent or another student would explain it in a different way, and it clicked. Or perhaps it just took more time. Other times we figured things out faster than our classmates. We grew bored when the class repeatedly drilled a concept for those who struggled to get it. And most of us had friends who excelled in certain classes but struggled in others. Our experience is that we learn differently.

In the last three decades, increasing numbers of cognitive psychologists and neuroscientists have acknowledged this, too. Researchers have produced a multitude of schemes to explain the straightforward idea that people learn differently from one another. This research has bubbled up under different rubrics. While there is considerable certainty that people in fact learn differently, considerable uncertainty persists about what those differences are. At the moment the only sure thing is no one has yet defined these differences so unambiguously that there is consensus on what the types of intelligence or styles of learning specifically are. Food fights periodically erupt in graduate schools of education about what the salient differences are. As our understanding of the brain improves, we will better understand how it processes information—how neurotransmitters fire across synapses, which parts of the brain do what, how these develop, and so on—so we can better understand how different people learn. As neuroscientists help us to understand these underlying causal mechanisms, we will then be able to understand some of the mysteries of how human beings learn and what role our environment and experiences have on that ability. For now, however, the uncertainty persists.

In this book, we consciously avoid the controversies about whose definition of these differences is correct by making a simple assertion—people learn in *different ways*. Some of this difference is coded in our brains when we are born; other differences emerge based on what we experience in life, especially in our earliest years.

In this book, we use one of the more well known of these rubrics to illustrate what we mean by these differences, and

while you might not agree with the schematic we chose, that's not the point. In the pages that follow we employ language about people possessing different intelligences, but thinking about this as people having different aptitudes is fine as well. We merely introduce this theory of different intelligences so that readers can visualize how students might learn in different ways, whether the *domain* or *field* is math or music, languages or science.<sup>1</sup>

## ❖ RETHINKING INTELLIGENCE AND HOW WE LEARN

Research from academic psychologists has set the stage for an escape into a new understanding of intelligence. In the past, scholars reduced intelligence to a number, considered it unitary, and gave it a name—intelligence quotient, or IQ. They then proceeded to compare people within age groups by this measure. But some research indicates that intelligence is much broader than this. Many scholars use the word intelligence to denote competence in a variety of areas. The result is a proliferation of definitions of intelligence.<sup>2</sup>

Harvard psychologist Howard Gardner is the pioneer in this multiple intelligences field. Gardner first posited the idea of many types of intelligence in the early 1980s as he introduced his “theory of multiple intelligences.”<sup>3</sup> A cursory examination of Gardner’s definition of intelligence and his categorization scheme shows how people can have different strengths and how the learning experience can be tailored to those differences. Here’s how Gardner defines intelligence:

- The ability to solve problems that one encounters in real life.
- The ability to generate new problems to solve.
- The ability to make something or offer a service that is valued within one’s culture.<sup>4</sup>

That definition escapes the narrow clutches of an IQ score. In studying intellectual capacity, Gardner established criteria

to aid him in deciding whether a talent that could be observed was actually a distinct intelligence and therefore whether it merited its own spot in his categorization scheme. His criteria are that “each intelligence must have a developmental feature, be observable in special populations such as prodigies or “savants,” provide some evidence of localization in the brain, and support a symbolic or notational system.”<sup>5</sup> From this, Gardner originally came up with seven distinct intelligences. He has since added an eighth to that list and given consideration to a couple more.

Gardner’s eight intelligences with brief definitions and an example of someone who exemplifies each one are:

- *Linguistic*: Ability to think in words and to use language to express complex meanings: Walt Whitman.
- *Logical-mathematical*: Ability to calculate, quantify, consider propositions and hypotheses and perform complex mathematical operations: Albert Einstein.
- *Spatial*: Ability to think in three-dimensional ways; perceive external and internal imagery; re-create, transform, or modify images; navigate oneself and objects through space; and produce or decode graphic information: Frank Lloyd Wright.
- *Bodily-kinesthetic*: Ability to manipulate objects and fine-tune physical skills: Michael Jordan.
- *Musical*: Ability to distinguish and create pitch, melody, rhythm, and tone: Wolfgang Amadeus Mozart.
- *Interpersonal*: Ability to understand and interact effectively with others: Mother Teresa.
- *Intrapersonal*: Ability to construct an accurate self-perception and to use this knowledge in planning and directing one’s life: Sigmund Freud.
- *Naturalist*: Ability to observe patterns in nature, identify and classify objects, and understand natural and human-made systems: Rachel Carson.<sup>6</sup>

How does this relate to teaching and learning? When an educational approach is well aligned with one's stronger intelligences or aptitudes, understanding can come more easily and with greater enthusiasm. Put differently, the learning can be intrinsically motivating. For example, in the above story, Rob struggled to grasp the material when the teacher taught it in a logical-mathematical form. Almost surely this form of intelligence is not one of his strengths. His classmate, Maria, has a high logical-mathematical intelligence, so she grasped it immediately. But when his father demonstrated the same concept to Rob in a different, spatial way that aligned with how Rob learns, he not only understood, but found it interesting.<sup>7</sup>

Gardner and others have researched ways to teach various content materials so that they are in line with each of these intelligences. In the book *Teaching and Learning through Multiple Intelligences*, the authors Linda Campbell, Bruce Campbell, and Dee Dickinson demonstrate this by telling a story about a girl who was several grade levels behind in school. The more she struggled, the more she hated school—and her self-esteem plummeted. When she entered the sixth grade, she had a teacher who observed how gracefully she moved, which prompted the teacher to wonder if she might learn through movement. Without being an expert in intelligence typologies, that teacher could see that this student had the gift of great bodily-kinesthetic intelligence. The student generally refused to read, write, or practice spelling. But following her hunch, the teacher suggested to the girl that she “create a movement alphabet using her body to form each of the twenty-six letters.” The next day, the girl ran into the classroom before school started with something to show her teacher. She danced each letter of the alphabet and then sequenced all twenty-six into a unified performance. She then spelled her first name and last name through dancing. That night she practiced all her spelling words through dancing—and performed the dance for her classmates the next day. Soon she began writing more and

more words. First she would dance them; then she wrote them down. Her writing scores increased, as did her self-confidence. A few months later she no longer needed to dance out words to spell them; learning through her strength in bodily-kinesthetic intelligence had opened a world of reading and writing to her forever. These skills are important no matter what path she pursues in life.<sup>8</sup>

Gardner's research shows that although most people have some capacity in each of the eight intelligences, most people excel in only two or three of them. His research, while implying the need for learning opportunities that line up with individual strengths, also cautions against pigeonholing people and not developing all their intelligences.

In addition, these differences in intelligences are only one dimension of cognitive ability. Within each type of intelligence there are different *learning styles*. Some students most easily comprehend through visual means. Others need to talk it through, write it down, play it out, and so on. And a person who learns best with a visual learning style for one type of intelligence—by seeing images or reading text—may not necessarily do well using that same learning style when using another type of intelligence. Finally, nested within each learning style, there is a third dimension of difference. People learn at different *paces*—slow, medium, fast, and all the variations within.

Given that we all learn in different ways, one might assume that we would teach in different ways, too. But think back to your experience in school. Because schools place students in groups, when a class was ready to move on to a new concept, all students moved on, regardless of how many had mastered the previous concept (even though it might have been a prerequisite for understanding what came next). When it was time to take Algebra 2, even if we had not yet mastered all the requisites in Algebra 1, we took Algebra 2. Some people moved on even if they did not pass the prerequisite class. Conversely, it did not matter if some percentage of students could cover the World History curriculum in a quarter; everyone

was stuck in the class for a full year. And when our fourth-grade teacher taught long division in the manner that corresponded to how she best learned it and understood it, maybe it clicked for us and maybe not; whether we understood it right away and became bored with the repeated explanations or sank deeper into bewilderment, unable to grasp the logic, we sat in the class for the duration.<sup>9</sup>

Why do schools work this way? If we agree that we learn differently and that students need customized pathways and paces to learn, why do schools standardize the way they teach and the way they test?

## ❖ INTERDEPENDENCE AND MODULARITY

To explain this conflict between schools standardizing the way they teach in the face of students needing customization for the way they learn, we first need to step back and understand the concepts of interdependence and modularity from the world of product design.

All products and services<sup>10</sup> have an architecture, or design, that determines what its parts are and how they must interact with each other. The place where any two parts fit together is called an *interface*. Interfaces exist within a product, as well as between groups of people or between departments within an organization that must interact with one another.

A product's design is interdependent if the way one component is designed and made depends on the way other components are designed and made—and vice versa. When there is an unpredictable interdependency across an interface between components—that is, we can't know ahead of time how we must build a certain part until we have built both parts together—then the same organization must develop *both* of the components if it hopes to develop *either* component. These architectures are almost always proprietary because each organization will develop its own interdependent design to optimize performance in a different way.

By contrast, in a modular product design, there are no unpredictable interdependencies in the design of the product's components or stages of the value chain. Modular components fit and work together in well-understood, crisply codified ways. A modular architecture specifies the fit and function of all elements so completely that it does not matter who makes the components or subsystems as long as they meet the defined specifications. Modular components can be developed in independent work groups or by different organizations working at arm's length.

To illustrate, consider the "architecture" of an electric light. A light bulb and a lamp have an interface between the light bulb stem and the light bulb socket. This is a modular interface. Engineers have lots of freedom to improve the design *inside* the light bulb, as long as they build the stem so that it can fit the established light bulb socket specifications. Notice how easily the new compact fluorescent bulbs fit into our old lamps. The same company does not need to design and make the light bulb, the lamp, the wall sockets, and the electricity generation and distribution systems. Because standard interfaces exist, different companies can provide products for each piece of the system.

When there is an interdependent interface, by contrast, integration across that interface is essential. For example, when Henry Ford built his high-volume Model T assembly line in Dearborn, Michigan, he learned a painful truth. When his workers pressed a flat sheet of steel into a die to form it into the shape of an auto-body part, the steel did not conform itself precisely to the die's shape (which is the metalworker's equivalent of a mold). Instead, the steel sprang back somewhat after it was fully pressed into the die. Ford's die makers could cut the dies slightly deeper to account for this spring-back. But if the batch of steel that was delivered from Ford's supplier on Monday sprang back 2 percent, while Tuesday's batch of steel sprang back 6 percent, then the size of the parts would vary by as much as 4 percentage points from one day to the

next—and the pieces of the car just wouldn't fit together. Working independently, the steel suppliers couldn't solve this problem because they weren't stamping the steel in Ford's environment. And Ford couldn't solve it because he wasn't making the steel. So Ford integrated. He built a massive steel complex on the River Rouge west of Detroit so that as his engineers worked to control the metallurgical properties of the steel, they could interdependently change the way the dies and stamping machines were designed and used.

When someone changes one piece in a product that has an interdependent architecture, necessity requires complementary changes in other pieces. Customizing a product or service, as a result, becomes complicated and expensive. Many of these interdependencies are not predictable so all pieces must be designed interactively. Customizing a product whose architecture is interdependent requires a complete redesign of the entire product or service every time.

On the other hand, modular architectures optimize flexibility, which allows for easy customization. Because people can change pieces without redesigning everything else, real customization for different needs is relatively easy. A modular architecture enables an organization to serve these needs. Modularity also opens the system to enable competition for performance improvement and cost reduction of each module.

The level of interdependence found in a product is a function of the underlying technology's maturity. In the early days of most new products and services, the components need to be tightly woven together to maximize the functionality from an immature technology that is not yet good enough to satisfy customer needs. Customers are willing to tolerate the product standardization that component interdependence mandates because customization is prohibitively expensive. They are generally willing to conform their expectations and their behavior to accommodate use of the standard product. Differences in usage patterns—and therefore customers' individual needs—are not obvious during this stage of an industry's evolution.

As an illustration, Apple led the charge in the 1980s at the outset of the personal computer revolution by controlling essentially the whole computer—from the hardware and operating system to the software applications. The architecture of this system was proprietary and interdependent. The unfortunate downside, however, was that customization was prohibitively expensive for Apple.

As products and their markets mature, technology grows more sophisticated, as do customers. They begin to understand their unique needs and to insist on customized products. Technological maturity makes customization possible. Product and service architectures become more modular in this environment. In the early days of personal computers, a modular offering was not possible. But the technology matured, which made the Dell approach to satisfying different customer needs a realistic option. Peeling the cover off a Dell reveals that Dell does not manufacture any of the components. A different company makes each. This allows Dell to invite its customers to specify the features and functions they want and then to assemble and deliver a customized computer within 48 hours.

The personal computer operating system is currently going through the same evolution. Microsoft's Windows Operating System is interdependent. Changing just ten lines of code could necessitate rewriting millions of others. It would cost millions of dollars to customize Windows exactly to your needs. The economics of interdependence mandate standardization, and we live with it. Most of us are unaware of how our lives might improve if we had easily configurable operating systems at our disposal; it's just a luxury that had never been feasible. Once Unix technology had matured sufficiently, however, an open-source operating system such as Linux became feasible. Linux's architecture is modular and can be customized—witness how the open-source programming community continually updates and enhances it, kernel by kernel.

## ❖ THE SCHOOLING DILEMMA: STANDARDIZING TEACHING VERSUS CUSTOMIZING LEARNING

How does this relate to U.S. public schools? Think about schooling's architecture. The dominant model today is highly interdependent. It is laced with four types of interdependencies. Some of these interdependencies are *temporal*: you can't study this in ninth grade if you didn't cover that in seventh. There are *lateral* interdependencies, too. You can't teach certain foreign languages in other more efficient ways because you'd have to change the way English grammar is taught; and changing the way grammar is taught would mandate changes elsewhere in the English curriculum. There are also *physical* interdependencies. There is strong evidence, for example, that project-based learning is a highly motivating way for many students to synthesize what they are learning as well as to identify gaps in their knowledge that need to be filled. But many schools can't adopt widespread project-based learning because the layout of their buildings simply can't accommodate it. And finally, there are *hierarchical* interdependencies. These range from well-intentioned mandates, which are often contradictory, from local, state, and federal policymakers that influence what happens in schools to union-negotiated work rules that become enshrined in contracts and policies at the state and local levels. Curriculum and textbook decisions made at school district headquarters also circumscribe the ability of teachers to innovate, especially across the curriculum. Although an innovative teacher might see a way to teach algebra in the context of chemistry, it would be nearly impossible to do it because the structure of what can be taught in the classroom depends on how the district headquarters carves up and defines the curriculum; and changes in the curriculum would also require changes in standardized tests and admissions standards. Even more problematic, this kind of change in practice would

require changes in the way prospective science and math teachers are trained and certified.

Because there are so many points of interdependence within the public school system, there are powerful economic forces in place to standardize both instruction and assessment despite what we know to be true—students learn in different ways. The problem is that customization within interdependent systems is expensive. We explore how hierarchical interdependency restricts customization in much greater depth in Chapter 5 when we introduce the concept of a “commercial system,” but here’s one telling example to illustrate the point. In the 1960s and 1970s, society began requiring schools to customize offerings for students deemed to have special needs. By the 1970s, 10 percent of all children were covered by federally funded programs for children with special needs.<sup>11</sup> Students who qualify for these designations typically require individual approaches, codified in an individualized education plan (IEP). In another special case, educators place immigrant students from non-English-speaking families into custom-designed English language learner (ELL) programs. Customization is almost surely an important advantage for both these categories of students, but it is also terribly expensive. For example, in Rhode Island it costs \$22,893 a year on average to educate a special-education student, whereas it costs \$9,269 for a regular education student.<sup>12</sup> Spending increases for special education students have outpaced spending for regular education by a considerable margin over the last 40 years to the point where it now accounts for over a third of the spending in many districts.<sup>13</sup>

As a consequence, there is a constant struggle over who is eligible for “special” consideration, and, because those costs soak up so many resources (lower staff ratios, special spaces, tailored instructional approaches), schools increasingly standardize for everyone else.<sup>14</sup> But here is the dilemma: because students have different types of intelligence, learning styles, varying paces, and starting points, *all students* have special learning needs.<sup>15</sup> It is not just students whom we label as having

disabilities. Or, to put it as singer-songwriter Danny Deardorff did, we are all “differently abled.”<sup>16</sup> The students who succeed in schools do so largely because their intelligence happens to match the dominant paradigm in use in a particular classroom—or somehow they have found ways to adapt to it.<sup>17</sup>

## ❖ CAN WE CUSTOMIZE ECONOMICALLY WITHIN THE PRESENT FACTORY MODEL SCHOOLS?

In the one-room schools that characterized public education during most of the 1800s, teaching was customized by necessity, at least by pace and level. Because the room was filled with children of different ages and abilities, teachers spent most of their day going from student to student, giving personalized instruction and assignments, and following up in individually tailored ways. But as classrooms filled in the late 1800s, this method of teaching changed as larger enrollments forced schools to standardize. Americans tolerated it; progressive thinkers from earlier generations encouraged it. Just as in the early stages of other industries’ histories, society’s expectations and behaviors actually conformed to the standardization; Americans no longer expected customized learning. Much of the support behind this standardization—categorizing students by age into grades and then teaching batches of them with batches of material—was inspired by the efficient factory system that had emerged in industrial America. By instituting grades and having a teacher focus on just one set of students of the same academic proficiency, the theory went, teachers could teach “the same subjects, in the same way, and at the same pace” to all children in the classroom.<sup>18</sup>

The question now facing schools is this: Can the system of schooling designed to process groups of students in standardized ways in a monolithic instructional mode be adapted to handle differences in the way individual brains are wired for learning?<sup>19</sup>

Some school districts have made efforts to personalize learning, and many schools have attempted to use Gardner’s frame-

work to teach to multiple intelligences within a classroom. But because of the high level of interdependence in a classroom, this is not an easy thing to do successfully on a large scale. Montgomery County Public Schools in Maryland, for example, has begun instituting forms of personalized learning to take into account varied learning styles. Through real-time assessments, such as those offered by Wireless Generation,<sup>20</sup> a company that provides mobile educational assessment solutions, teachers gain insight into where students actually are in their learning so that they can then tailor instruction to each student.

The Maryland effort is a noble one. But teaching to multiple intelligences in a monolithic model is fraught with problems. While most students have some capacity in each of the eight intelligences, most truly excel in only two or three of the intelligences. Teachers, of course, are no different and excel in a discrete number of styles. Like all of us, they therefore tend to teach in ways compatible with their strengths.

What happens then in the typical classroom is a kind of “reverse magnetic attraction.” Every magnet, you may remember, has a positive and a negative pole. Like poles repel each other, and opposite poles attract. In the typical classroom, those “like poles”—similar types of intelligence—attract, rather than repel, each other.

This reverse magnetic attraction creates a vicious cycle. The teachers in classrooms are products of the monolithic batch-processing system that characterizes public education today. In that system, students who naturally enjoy the teaching approach they encounter in a given class are more likely to excel. For example, the subject material in a high school language arts class relates in obvious ways to linguistic intelligence. Students with that intelligence type naturally comprise most of the ones who excel in language arts. They’re the ones who choose to major in that subject in college and then choose teaching careers in that field. Specific subject matter tends to be linked to specific intelligences through the way textbooks are written—by experts strong in that specific intelligence

type. As a result, what has emerged in every domain are “intellectual cliques,” composed of curriculum developers, teachers, and the best students in that subject area. Their brains are all wired consistently with each other. Just as members of a social clique often are unaware of the degree to which they easily understand and communicate with each other to the exclusion of those outside the group, members of these intellectual cliques are often unaware of the extent to which their shared patterns of thinking exclude those with strengths in other kinds of intelligences.

Students not endowed with strong linguistic intelligence are therefore predictably frustrated in an English class. Teachers are similarly trapped by their own strengths. In any given classroom there are students who do not have strong linguistic intelligence and are therefore effectively excluded from excelling in this subject. And the pattern repeats itself from generation to generation. The same happens in each of the academic disciplines. For example, teachers who teach math tend to have high logical-mathematical intelligence, and therefore the students who excel in their classes also tend to have this type of intelligence. Many other students are excluded.

Gardner and others who agree with him work to train teachers and schools to teach to multiple intelligences. This effort is more manageable at the elementary school level with its activity-center, exploratory learning model. But in most U.S. schools, especially at the middle and high school level, even a heroic effort by a teacher to pay attention to multiple intelligence patterns is, because of the way the system is arranged around the monolithic architecture, almost guaranteed to fail. When that teacher caters to one type of intelligence, some students will tune in, but others will tune out.

In summary, the current educational system—the way it trains teachers, the way it groups students, the way the curriculum is designed, and the way the school buildings are laid out—is designed for standardization. If the United States is serious

about leaving no child behind, it cannot teach its students with standardized methods. Today's system was designed at a time when standardization was seen as a virtue. It is an intricately interdependent system. Only an administrator suffering from virulent masochism would attempt to teach each student in the way his or her brain is wired to learn within this monolithic batch system. Schools need a new system.

## ❖ THE POTENTIAL FOR CUSTOMIZED LEARNING IN STUDENT-CENTRIC CLASSROOMS

If the goal is to educate every student—asking schools to ensure that all students have the skills and capabilities to escape the chains of poverty and have an all-American shot at realizing their dreams—we must find a way to move toward what, in this book, we call a “student-centric” model. We use the word *toward* intentionally here, because this is not, at least immediately, a binary choice. A monolithic batch process with all of its interdependencies is at one end of a spectrum, and a student-centric model that is completely modular is at the other. For a very long time there will be some issues, skills, and subjects that the traditional model will handle best. But one by one, the instructional jobs that teachers now shoulder are destined, as we will show, to migrate toward a student-centric model.

How might schools start down this promising path? Computer-based learning, which is a step on the road toward student-centric technology, offers a way. As we explain in subsequent chapters, computer-based learning is emerging as a disruptive force and a promising opportunity. The proper use of technology as a platform for learning offers a chance to modularize the system and thereby customize learning. Student-centric learning is the escape hatch from the temporal, lateral, physical, and hierarchical cells of standardization. The hardware exists. The software is emerging. Student-centric learning opens the door for students to learn in ways that

match their intelligence types in the places and at the paces they prefer by combining content in customized sequences. As modularity and customization reach a tipping point, there will be another change: As we explain later, teachers can serve as professional learning coaches and content architects to help individual students progress—and they can be a guide on the side, not a sage on the stage.

Is this a pipe dream? How can schools, which are public institutions driven by political decisions and seemingly insulated from market demands, make the shift to a student-centric classroom? In the following chapter, we show that historically schools have in fact done a remarkable job of shifting to meet the public's demands. Explaining the disruption theory and a brief history of schooling in the United States shows that schools actually have consistently improved over time. Although it won't be easy, we think they can make this shift to a student-centric classroom, too, if they take the right steps forward.

## NOTES

1. The Ball Foundation puts forth a different rubric from the primary one we use in this book, for example. It has done significant work exploring people's different aptitudes and what this means for their learning. From a Web site about The Ball Foundation's Ball Aptitude Battery: "An individual's aptitudes are a primary factor in identifying the types of skills one can expect to learn most quickly and easily. This in turn is a predictor of the types of tasks that an individual is likely to enjoy. So an individual who understands their own aptitude profile can be more confident that their time and energy is invested in education that is going to offer the greatest rewards." "The Ball Aptitude Battery," Career Vision Web site, <http://www.careervision.org/About/BallAptitudeBattery.htm> (accessed April 1, 2008).
2. Many researchers have proposed different categories or types of intelligence. Among the categories are Peter Salovey and John Mayer's emotional intelligence. See P. Salovey and J. D. Mayer, "Emotional intelligence," *Imagination, Cognition, and Personality* (1990), pp. 9, 185–211.  
Daniel Goleman's latest book is about social intelligence, another category of intelligence. See Daniel Goleman, *Social Intelligence: The New Science of Human Relationships* (New York: Bantam, 2006).

Robert Sternberg has developed a multiple intelligences theory, which pinpoints three intelligence types—analytical, creative, and practical—based on his own definition of intelligence that is culturally dependent and broader than the traditional measure. R. J. Sternberg, *Beyond IQ: A Triarchic Theory of Human Intelligence* (New York: Cambridge University Press, 1985).

In a different line of work, Sally Shaywitz has broken new ground in understanding how one set of people, those with dyslexia, learn differently from others. Shaywitz's research details how dyslexics' brains actually function differently from others through the use of correlations in MRIs of the brain. See Sally Shaywitz, *Overcoming Dyslexia: A New and Complete Science-Based Program for Reading Problems at Any Level* (New York: Random House, 2003).

3. Howard Gardner, *Multiple Intelligences* (New York: Basic Books, 2006), p. 6.

Gardner also recently published a delightful book in which he summarizes as faithfully as possible the strongest arguments against his work, and then offers his responses. See Ed. Jeffrey A. Schaler, *Howard Gardner Under Fire: The Rebel Psychologist Faces His Critics* (Chicago: Open Court, 2006).

4. Linda Campbell, Bruce Campbell, and Dee Dickinson, *Teaching and Learning through Multiple Intelligences* (Boston: Pearson, 2004), p. xx.

5. Campbell et al., p. xix.

6. Campbell et al., p. xxi.

7. Jack Frymier, who has spent his life in public education as a teacher, administrator, professor, and researcher, provides more insight into why this would be more intrinsically motivating. Because motivation is an individual matter and children differ from one another, it stands to reason that different things motivate different children. No effort at instilling intrinsic motivation will succeed unless it works with these differences. See Jack Frymier, "If Kids Don't Want to Learn You Probably Can't Make 'em: Discussion with Jack Frymier" notes by Ted Kolderie (October 28, 1999), [http://www.educationevolving.org/content\\_view\\_all.asp](http://www.educationevolving.org/content_view_all.asp).

8. Campbell et al., pp. 63–64.

9. Gardner's research supports this. Schools and standardized tests tend to emphasize linguistic and logical-mathematical intelligence and ignore the other kinds of intelligences. And most teachers tend to rely on one or two intelligences at the exclusion of the others. Campbell et al., pp. xx, xxiii.

In a *Time* magazine story on high school dropouts, the article cited that of the 30-plus percent of high school students who did not finish school, 88 percent of those dropping out had passing grades when they left. Dropouts frequently report boredom as the reason for leaving. Nathan Thornburgh, "Dropout Nation," *Time*, April 9, 2006, <http://www.time.com/time/printout/0,8816,1181646,00.html>.

10. We sometimes use the word "product" exclusively, but in this context, it serves as a synonym for "service." The concepts of interdependence and modularity and their implications apply equally to both products and services; we use the word "product" most of the time to simplify the text.

11. David Tyack and Larry Cuban, *Tinkering Toward Utopia: A Century of Public School Reform* (Cambridge, Massachusetts: Harvard University Press, 1995), p. 25.
12. Jennifer D. Jordan, "Special-Needs Students Apart," *Providence Journal*, February 8, 2007, [http://www.projo.com/education/content/special\\_education21\\_01\\_21-07\\_P83O6B6.15f1fb4.html](http://www.projo.com/education/content/special_education21_01_21-07_P83O6B6.15f1fb4.html).
13. Stacey Childress and Stig Leschly, "Note on U.S. Public Education Finance (B): Expenditures," HBS Case Note, November 2, 2006, p. 5.
14. An article in *Threshold* paints a picture of how teachers who aim to customize for struggling students give less attention to others in the class. "Personalization in the Schools: A Threshold Forum," *Threshold*, Winter 2007, p. 13.
15. An article in *Threshold* brings this point to life with some in-depth and concrete examples. See Dianne L. Ferguson, "Teaching Each and Every One: Three Strategies to Help Teachers Follow the Curriculum While Targeting Effective Learning for Every Student," *Threshold*, Winter 2007, p. 7.
16. Campbell et al., p. 127.
17. There actually is some modularity and customization in public schools. In the youngest grades, during parts of the day, students often can stay at various learning centers as long as they choose, before moving to other centers. In high school, students have considerable choice in the classes they take. These options allow them to customize what they learn. But they have little freedom to choose how they will learn it—and that is the challenge.
18. Tyack and Cuban, p. 89.  
 Also, as ethnographer Herb Childress has written, U.S. high schools are "additive" factories in which multiple certified specialists screw on their component and pass the child along to another; some screw on algebra, others world history, others Hemingway. He infers that high school is devoted to a set of processes above all else. We delve into this idea more in Chapter 5 when we explain the concept of the value-chain business. Herb Childress, *Landscapes of Betrayal, Landscapes of Joy: Curtisville in the Lives of Its Teenagers* (New York: SUNY Press, 2000).
19. Success for All is an example of a "batch processing" system that has tried to customize. It is a reading program that groups kids by ability. It has a tight feedback loop where it frequently assesses and regroups its students as it attempts to teach students at their level. It doesn't target different learning styles, however. It is a slight improvement over the lock-step system and it points in the direction of mass customization. But it's still stuck in the monolithic paradigm of schooling.
20. Among its assessments, Wireless Generation offers teachers an improved way to conduct early reading assessments. Teachers have a handheld device that they use when administering a reading assessment. When the session is over, the teacher has captured a rich set of data about the student in a far easier manner than was previously possible. Teachers can then sync the

handheld to a Web site to view and analyze reports on the student as well as the whole class. They can then use this information to tailor instruction to the students' needs—and Wireless Generation's product offers guidance here, too.