Is K-12 Blended Learning Disruptive?

An introduction to the theory of hybrids

by Clayton M. Christensen, Michael B. Horn, and Heather Staker

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EXECUTIVE SUMMARY

The Clayton Christensen Institute, formerly Innosight Institute, has published three papers describing the rise of K–12 blended learning—that is, formal education programs that combine online learning and brick-and-mortar schools.[1] This fourth paper is the first to analyze blended learning through the lens of disruptive innovation theory to help people anticipate and plan for the likely effects of blended learning on the classrooms of today and schools of tomorrow. The paper includes the following sections:

Introduction to sustaining and disruptive innovation

There are two basic types of innovation—sustaining and disruptive—that follow different trajectories and lead to different results. Sustaining innovations help leading, or incumbent, organizations make better products or services that can often be sold for better profits to their best customers. They serve existing customers according to the original definition of performance—that is, according to the way the market has historically defined what's good. A common misreading of the theory of disruptive innovation is that disruptive innovations are good and sustaining innovations are bad. This is false. Sustaining innovations are vital to a healthy and

robust sector, as organizations strive to make better products or deliver better services to their best customers.

Disruptive innovations, in contrast, do not try to bring better products to existing customers in established markets. Instead, they offer a new definition of what's good—typically they are simpler, more convenient, and less expensive products that appeal to new or less demanding customers. Over time, they improve enough to intersect with the needs of more demanding customers, thereby tranforming a sector. Examples in the paper from several industries demonstrate the classic patterns of both types of innovation.

Theory of hybrids

Often industries experience a hybrid stage when they are in the middle of a disruptive transformation. A hybrid is a combination of the new, disruptive technology with the old technology and represents a sustaining innovation relative to the old technology. For example, the automobile industry has developed several hybrid cars along its way to transitioning from gasoline-fueled engines to engines with alternative power sources. The leading companies want the virtues of both, so they have developed a sustaining innovation—hybrid cars that use both gasoline and electricity. Other industries—including earth excavators, steamships, photography, retail, and banking—have experienced a hybrid stage on their way to realizing the pure disruption. Industries create hybrids for predictable reasons, including because the business case for the purely disruptive technology is not compelling at first to industry leaders, whereas implementing a hybrid as a sustaining innovation allows incumbents to satisfy their best customers.

How to spot a hybrid

Hybrid innovations follow a distinct pattern. These are four characteristics of a hybrid:

1. It includes both the old and new technology, whereas a pure disruption does not offer the old technology in its full form.

2. It targets existing customers, rather than nonconsumers—that is, those whose alternative to using the new technology is nothing at all.

3. It tries to do the job of the preexisting technology. As a result, the performance hurdle required to delight the existing customers is quite high because the hybrid must do the job at least as well as the incumbent product on its own, as judged by the original definition of performance. In contrast, companies that succeed at disruptive innovations generally take the capabilities of the new technology as a given and look for markets that will accept the new definition of what's good.

4. It tends to be less "foolproof" than a disruptive innovation. It does not significantly reduce the level of wealth and/or expertise needed to purchase and operate it.

Importantly, where there is no nonconsumption in a market, a hybrid solution is the only viable option for a new technology that underperforms the old based on the original definition of performance. That means that in markets with full consumption, hybrid innovations tend to dominate instead of pure disruptions.

Hybrid models of blended learning

In many schools, blended learning is emerging as a hybrid innovation that is a sustaining innovation relative to the traditional classroom. This hybrid form is an attempt to deliver "the best of both worlds"—that is, the advantages of online learning combined with all the benefits of the traditional classroom. In contrast, other models of blended learning appear *disruptive* relative to the traditional classroom. They do not include the traditional classroom in its full form; they often get their start among nonconsumers; they offer benefits that accord to a new definition of what's good; and they tend to be more foolproof to purchase and operate.

In terms of the emerging blended-learning taxonomy, the Station Rotation, Lab Rotation, and Flipped Classroom models are following the pattern of sustaining hybrid innovations. They incorporate the main features of both the traditional classroom and online learning. The Flex, A La Carte,* Enriched Virtual, and Individual Rotation models, in contrast, are developing more disruptively relative to the traditional system.

Seeing what's next with blended learning

The models of blended learning that follow the hybrid pattern are on a sustaining trajectory relative to the traditional classroom. They are poised to build upon and offer sustaining enhancements to the factory-based classroom system, but not disrupt it. The models that are more disruptive, however, are positioned to transform the classroom model and become the engines of change over the longer term, particularly at the secondary level. Any hybrid variety of blended learning is likely to fall by the wayside as the pure disruption becomes good enough.

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* This paper introduces a name change to the blended-learning taxonomy described in "Classifying K–12 blended learning." That paper defined four blended-learning models, one of which is the Self-Blend model. This paper replaces the name of the Self-Blend model with the "A La Carte" model. The reason for this change is that the term "self-blend" implies that students are making the decision themselves to take an online course to supplement their traditional program. In fact, many times other people make that choice. For example, a school might use the A La Carte model to offer online Chinese courses, rather than hire a face-to-face Chinese teacher. The definition of the A La Carte model is slightly changed to reflect this nuance. This is the new definition: "A La Carte model—a program in which students take one or more courses entirely online with an online teacher of record and at the same time continue to have brick-and-mortar educational experiences. Students may take the online courses either on the brick-and-mortar campus or off-site."

When this happens, the fundamental role of brick-and-mortar schools will pivot. Schools will focus more, for example, on providing well-kept facilities that students want to attend with great face-to-face support, high-quality meals, and a range of athletic, musical, and artistic programs and will leverage the Internet for instruction.

Although traditional and hybrid classrooms are poised for disruption, we do not see brick-and-mortar schools falling by the wayside any time soon. This is because although many areas of nonconsumption exist at the classroom level—particularly in secondary schools—little nonconsumption exists at the school level in the United States. Almost every student has access to a government-funded school of some sort. We predict that hybrid schools, which combine existing schools with new classroom models, will be the dominant model of schooling in the United States in the future. But within secondary schools, the disruptive models of blended learning will substantially replace traditional classrooms over the long term. In the paper, we conclude that the models that are more disruptive—Flex, A La Carte, Enriched Virtual, and Individual Rotation—are positioned to transform the classroom model and become the engines of change over the longer term in high school and middle school, but likely not in elementary school.

Implications for education leaders

Education leaders can use the disruptive innovation lens to anticipate the effects of their efforts. Strategies that sustain the traditional model could benefit students for years to come. This path is the best fit for most classroom teachers, school leaders who have limited budgetary or architectural control over their schools, and those who want to improve upon the classrooms in which most students receive their formal education today. Other strategies that accelerate the deployment of disruptive blended-learning models will have a greater impact on replacing the classroom with a student-centric design. This path is a viable fit for school principals—often in charters but also within districts, especially in those that have moved to portfolio models—that have some autonomy with respect to budget and school architecture. Furthermore, district leaders with authority to contract with online providers, state policy leaders, philanthropists, and entrepreneurs all are in the position to play a role in bolstering disruptive innovation.

Education leaders can foster disruptive innovation in several ways, including by following these five steps:

1. Create a team within the school that is autonomous from all aspects of the traditional classroom.

2. Focus disruptive blended-learning models initially on areas of nonconsumption.

3. When ready to expand beyond areas of nonconsumption, look for the students with less demanding performance requirements.

4. Commit to protecting the fledgling disruptive project.

5. Push innovation-friendly policy.

In the long term, the disruptive models of blended learning are on a path to becoming good enough to entice mainstream students from the existing system into the disruptive one in secondary schools. They introduce new benefits—or value propositions—that focus on providing individualization; universal access and equity; and productivity. Over time, as the disruptive models of blended learning improve, these new value propositions will be powerful enough to prevail over those of the traditional classroom.

INTRODUCTION

Innovation is not a black box. A set of remarkably consistent patterns offers a way for people to look into the future and anticipate where different innovations will lead. The patterns of disruptive and sustaining innovation have helped people foresee the effects of innovation in industries ranging from automobiles to energy to health care. The same patterns are now developing in K–12 education as online learning begins to transform schooling.

Disruptive and sustaining innovations leave very different footprints. In 2008, the authors of *Disrupting Class* showed that online learning bears the marks of a disruptive innovation. One element of this pattern is that disruptions first compete against "nonconsumption"—that is, among consumers whose alternative to using the new technology is nothing at all. True to the pattern, online learning took root initially in areas where students, educators, and families have found it to be better than the alternative—nothing at all. These areas include Advanced Placement and other specialized courses; small, rural, and urban schools that are unable to offer breadth; credit recovery; and high school dropouts and home-schooled students who had left the system.

A second element of the disruptive innovation pattern is that when one calculates the ratio of market share held by the new innovation divided by the old way of doing things and plots those results on a logarithmic scale, the data always fall on a straight line. That means that through a few calculations, analysts can predict when the disruptive technology will replace the established system. Online learning follows this principle, as the data suggest that by 2019, roughly 50 percent of high school courses will be delivered online in some form or fashion. That projection, now several years old, appears to be proving accurate with respect to the current growth rate of online learning in the K–12 sector. According to the International Association for K–12 Online Learning (iNACOL), there were nearly 2 million students taking at least one online course and 275,000 students enrolled in full-time virtual schools in the 2011–12 school year.[2]

A third element of a successful disruptive innovation is that it improves over time until it becomes good enough to meet the needs of mainstream consumers. Online learning is currently experiencing this upward march. Several sustaining innovations are making online learning better. Computing devices are becoming faster, less expensive, and more portable. Fiber optic cables are bringing larger and more reliable data streams to more communities around the world. Communications tools such as Skype, WebEx, and Elluminate are making synchronous virtual meetings more authentic and less expensive. Student data are becoming more accessible and useful. In some cases, content is becoming more engaging. And online learning is increasingly blending into physical environments so that students have access to the benefits of the schoolhouse while they learn.

This last development—which marks the advent of blended learning—is particularly important to the upward march of online learning. Although the number of home-schooled students has risen dramatically in recent years thanks in part to the growth in online-learning options, the increase in home schooling does not reflect a disruptive trend. In other words, when the growth is viewed on a logarithmic scale as described above, the practice of home schooling does not substitute for most children attending school. Instead, the projections suggest that, at the very most, 10 percent of students will switch to home schooling. The remaining 90 percent plus will continue to attend brick-and-mortar schools away from home.

Given that only a limited number of families have circumstances that allow for home schooling today, blended learning makes online learning possible for families that cannot support their children in either full-time home-school or full-time virtual-school environments. Blended learning allows those students to learn online while still benefiting from physical supervision and, in many cases, face-to-face instruction. Beginning in 2010, the Institute surveyed over 80 organizations and 100 educators involved with blended learning to arrive upon a definition that would best describe this phenomenon from the perspective of a student. The following is what has emerged:

> Blended learning is a formal education program in which a student learns at least in part through online learning with some element of student control over time, place, path, and/or pace *and* at least in part at a supervised brick-and-mortar location away from home.

One common feature of blended learning is that when a course takes place partly online and partly through other modalities such as small-group instruction, tutoring, and so forth, the modalities are usually connected. Students pick up where they individually left off when they switch from one modality to another. Accordingly, in this paper we recommend the following addendum to the above definition:

> The modalities along each student's learning path within a course or subject are connected to provide an integrated learning experience.

Figure 1 depicts a conceptualization of the complete definition.

The Institute has published a series of papers to describe the rise of K–12 blended learning in the United States.[3] The goal of that research was to define an emerging phenomenon and equip educators with a common language so that they could discuss and build on each other's ideas. This paper is the first to analyze blended learning through the lens of disruptive innovation theory. The goal this time is to use theories that have proved accurate in predicting the effects

Blended learning is a formal education program in which a student learns:

at least in part through online learning, with some element of student control over time, place, path, and/or pace;

+

at least in part in a supervised brick-and-mortar location away from home;

+

and the modalities along each student's learning path within a course or subject are connected to provide an integrated learning experience.

of innovation in countless other industries to help anticipate and plan for how blended learning is likely to affect the classrooms of today and schools of tomorrow.

The following section of this paper summarizes the theories of disruptive and sustaining innovations. Readers familiar with these theories may turn to page 15 to skip this review.

DISRUPTIVE AND SUSTAINING INNOVATIONS

The theory of disruptive innovation emerged originally from a study of the disk-drive industry to explain why the leading companies were unable to sustain their industry leadership from one generation to the next. The theory explains the histories of hundreds of industries or sectors where entrants have replaced the dominant companies or institutions. These range from product to service industries, for-profit to not-for-profit sectors, and slow- to fast-moving markets. *Figure 2* depicts elements of the theory.

We can view the history of most industries through the visual of a set of concentric circles, as Figure 2 shows, where the innermost circle represents customers who have the most money and skill and the outermost circle represents those who have the least. The initial products or services offered at the advent of most industries take root in the innermost circle; they are so expensive, complicated, and centralized that only those customers with lots of money or skill can use them. Disruption is the process by which such products become affordable and accessible to those in the outermost circles.

The blue diagram in the center of Figure 2 plots the performance of an innovation (the vertical axis) as measured over time (the horizontal axis). The model has two elements. First, in every market there is a trajectory of performance improvement that customers can utilize or absorb over time; the red-dotted line represents that trajectory. It has a gradual incline because most people do not demand much performance improvement from day to day. Their ability to use new and better

functionality increases only gradually. Anything additional overserves them.

Second, in every market there is a trajectory of technological progress, depicted in Figure 2 by the gray solid line that slopes more steeply upward. The most important finding about such trajectories is that the pace of technological progress almost always outstrips customers' ability to use the progress. A technology that is not good enough to meet customers' needs at one point in time, therefore, is very likely to improve such that it eventually becomes more than good enough. This is the point where the gray solid line intersects with and begins to outpace the red dotted line.

Figure 2. The theory of disruptive innovation
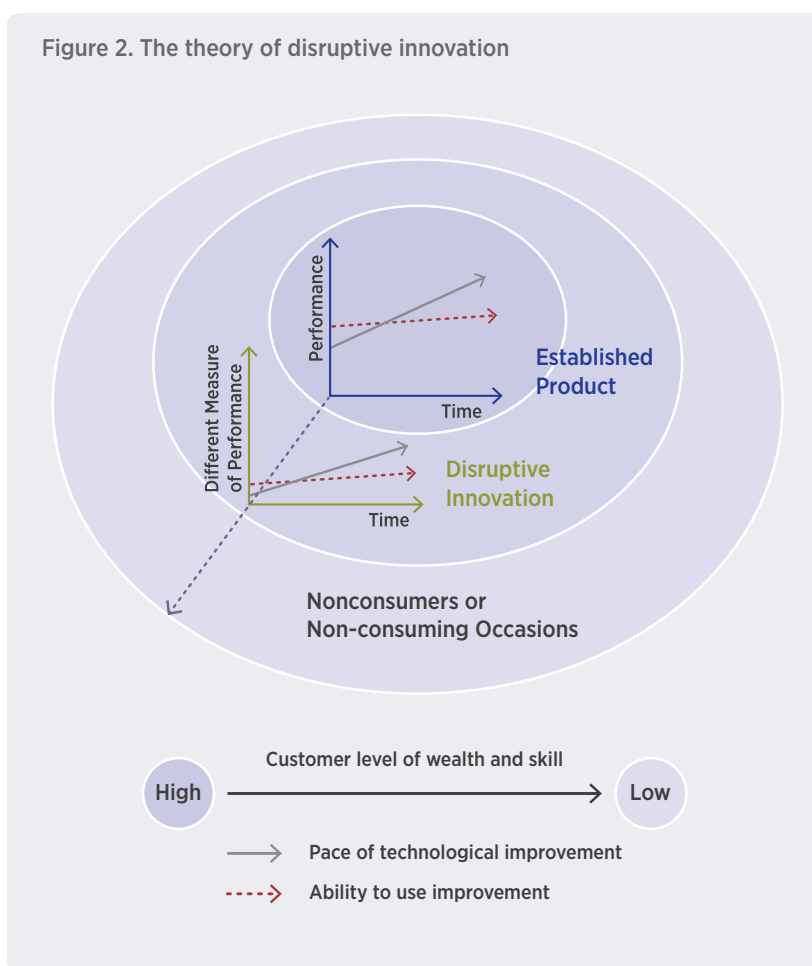
Sustaining innovations

Some of the innovations that improve product performance are incremental and others are dramatic breakthroughs. But we call both of these sustaining innovations so long as the purpose of the incremental and breakthrough innovations is the same—to help companies sustain their movement upward along the trajectory of performance improvement to make better products that can be sold for better profits to their best customers. The gray solid line in Figure 2 therefore represents sustaining innovations. The companies that lead their industries on the left end of the line, before the battles of sustaining innovation begin, are almost invariably still the leaders in their industries when those battles are over.[4] It does not matter how technologically difficult the innovations are. If their purpose is to help the leading companies in the industry make better products they can sell for better profits to their best customers, then they invariably find a way to do it.

> Disruption is the process by which products become affordable and accessible to the customers with the least amount of wealth and skill.

Disruptive innovations

On the other hand, disruptive innovations have historically proved almost impossible for the incumbent leaders in the industry to deploy successfully. The term "disruption" was chosen not because it represents a radical, breakthrough improvement along the existing trajectory depicted on the gray solid line in the center of Figure 2. Rather, it emerges in an entirely new "plane of competition," as shown by the green diagram in Figure 2. A disruptive innovation is one that replaces the original complicated, expensive product with something that is so much more affordable and simple that a new population of customers in the next larger circle now has enough money and skills to buy and use the product.

New entrants, rather than incumbent companies, almost invariably grow to dominate the industry when one of these disruptive innovations emerges. The reason is because when companies on the sustaining trajectory are faced with the choice of making better products that merit higher profit margins versus making simpler products with lower profit margins, they find it more attractive to build and offer more and better products. Profit maximization drives this decision in the for-profit world, but even in not-for-profit and governmental circumstances, incumbent organizations consistently choose to fight sustaining rather than disruptive battles. Though motivated by prestige rather than profit, their behavior is the same; they almost invariably favor sustaining strategies that allow them to offer better solutions that create more impact for their main clientele.

Examples of the process of disruption

The computer industry offers a clear example of the force of disruption at work. *Figure 3* depicts the waves of disruption that transformed computing.
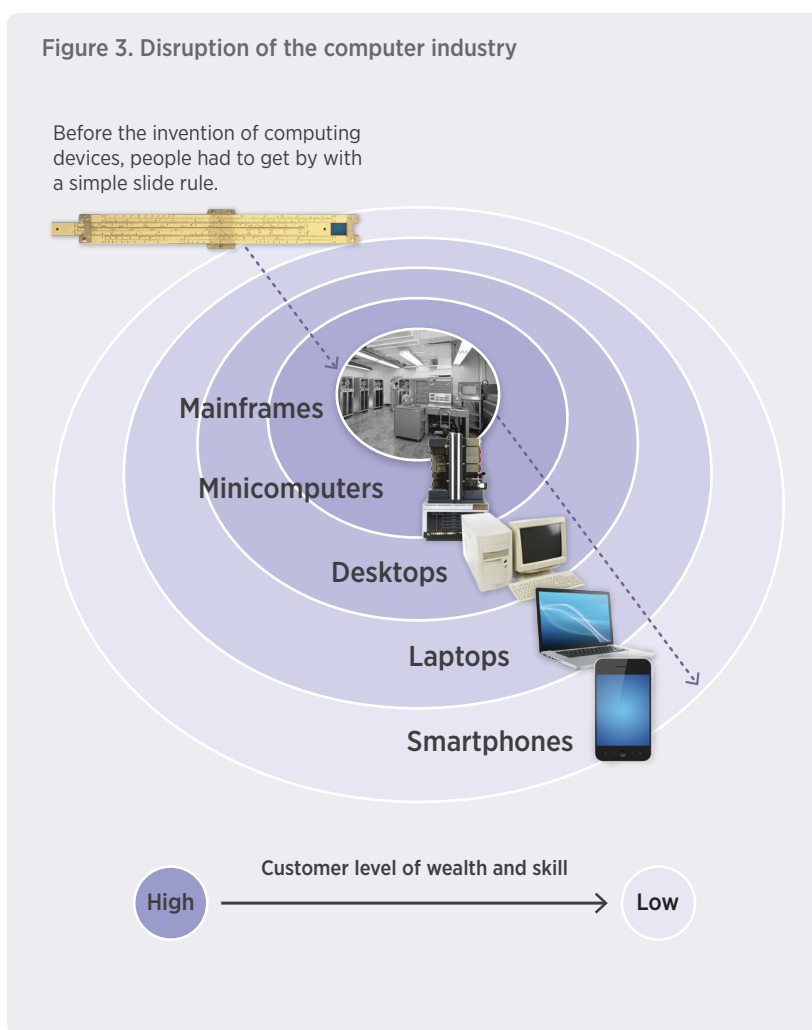
Before the invention of computing devices, people had to get by with a simple slide rule, as the outermost circle in Figure 3 depicts. It was simple, low cost, and worked for the masses of everyday people on the outer rim. Then, along came the invention of the mainframe computer, depicted at the center of Figure 3. Recall that the initial innovations at the emergence of most industries take root in the innermost circle because they are so expensive, complicated, and centralized that only the customers with the most money or skill can use them. Consistent with that pattern, mainframe computers were only accessible to corporations, universities, and other entities that could afford them. Companies such as IBM manufactured these huge machines from the 1950s to the 1970s, and their customers paid millions of dollars to buy them. The mainframe

companies focused their research and development on the sustaining strategy of making bigger and better mainframes.

The first disruptive innovation to shift the industry out of the center circle was the minicomputer. It still cost over $200,000, required an expert to operate it, and, despite its name, was still large. But relative to the mainframe, it was much smaller and less expensive, which made it accessible to a far wider population of people in companies and universities who previously did not have access to computers.

The personal computer was the next disruption. It was not a threat to mainframe and minicomputer makers at first. None of their customers could even use the personal computer for the first 10 years it was on the market because it wasn't good enough for the problems they needed to solve. The personal computer planted itself in areas of nonconsumption, as it served hobbyists and children at first. These people had no computing alternative to the personal computer, so they were delighted with a product that was infinitely better than nothing. But little by little the personal computer improved. At some point it became capable of doing work that previously required mainframes or minicomputers. This made computing widespread and cheaper, which left almost everyone better off, except for the mainframe and minicomputer makers, whose markets collapsed as people flocked to the personal computer.

The process of disruption continues to affect the computer industry, where laptops have disrupted personal computers, and now smaller mobile devices are gaining ground.

Figure 3. Disruption of the computer industry

Before the invention of computing devices, people had to get by with a simple slide rule.

Mainframes

Minicomputers

Desktops

Laptops

Smartphones

Customer level of wealth and skill

High   →   Low

Disruptive innovations have transformed countless other industries. Disruption has transformed consumer retailing, where discount retailers like Wal-Mart and Target have been replacing full-service department stores for several decades, and online retailers are now disrupting discount retailers. In the automobile sector, Korean manufacturers are displacing what once was the Japanese lead in the compact and subcompact markets, and Chinese manufacturers could eventually disrupt the Koreans. In higher education, the rapid growth of online learning is outpacing the growth of full-service universities and community colleges.

Since the publication of *Disrupting Class*, a common misreading of the theory of disruptive innovation has been that disruptive innovations are good and sustaining innovations are bad. This is false. Sustaining innovations are vital to a healthy and robust sector, as organizations strive to make better products or deliver better services to their best customers. The forces that propel well-managed organizations upmarket are always at work, and organizations rightly depend on them to get ahead of the crowd.

The distinction between the two types of innovation is not important, therefore, because it separates the good from the bad. Rather, it offers several other insights. It provides a framework for anticipating the direction in which the education sector will move over the long term because education models that successfully follow a disruptive strategy are on a path eventually to replace incumbent models. It also provides guidance to entrants who want to market new solutions. If their products or services are entering the market on a sustaining trajectory, the entrepreneurs should turn around and sell out to the industry leaders behind them because incumbents almost always win sustaining battles. Finally, the distinction is important because although disruption does not guarantee success, it is one sure element in the total formula for transforming an expensive, complicated industry.

THEORY OF HYBRIDS

As a disruptive innovation gets better and better, it begins to pull customers out of the original plane of competition and into the new one because customers find it more convenient to use the new product. But this transition is not always direct and straightforward. In the day-to-day and year-to-year of any transition, it is messy.[5]

Whenever a disruptive technology emerges, the leading firms in the field usually do not completely ignore it as they march forward with better products with higher profits for their best customers. Instead, they try to adopt the disruptive technology, but they do so through a sustaining strategy—they create a *hybrid*. The hybrid solution marries the old technology with the new in an attempt to create a "best of both worlds" alternative that the incumbent firms can market as a better product to their existing customers.

An example from an industry far outside of education helps to bring this phenomenon to light. Beginning in 1837, a technology shift occurred as people began to use steam shovels to excavate earth. Through World War II, a cadre of established firms led the excavation industry, as they managed the transition of sustaining innovations from steam-powered shovels to gasoline-powered ones and finally to excavators with diesel engines and electric motors.[6]

The buckets that excavated the earth for all these excavators were forward scooping and controlled through a series of pulleys, drums, and cables. Known as cable-actuated systems, by 1945 these excavators were able to dig big holes—roughly 5 cubic yards at a time for mining excavators, for example, where the capacity to dig big holes was critical. *Figure 4* shows a typical cable-actuated excavator.

The next technology shift had a different impact on the industry. After World War II, a new mechanism emerged for manipulating the bucket: a hydraulically actuated system. Ultimately only four of the roughly 30 established manufacturers of cable-actuated equipment survived and made the shift by the 1970s from cable-actuated to hydraulic systems. The companies that came to dominate the hydraulic excavation industry were all entrants.[7]

Hydraulic excavators worked differently from the cable ones. Rather than dig the earth in a forward scooping motion, the shovel faced backward and would extend out, drive into the earth, and then, with a curling motion, come up underneath the earth and lift it out of the hole. Hydraulic excavators were a classic disruptive innovation relative to the cable-actuated systems. They were limited by the strength and power of the available seals for the hydraulic pumps, so these early machines had the capacity of a mere quarter cubic yard, and they could only reach about 6 feet forward. *Figure 5* depicts one model of a hydraulic excavator.

**Figure 4. Cable-actuated mechanical shovel manufactured by Osgood General**
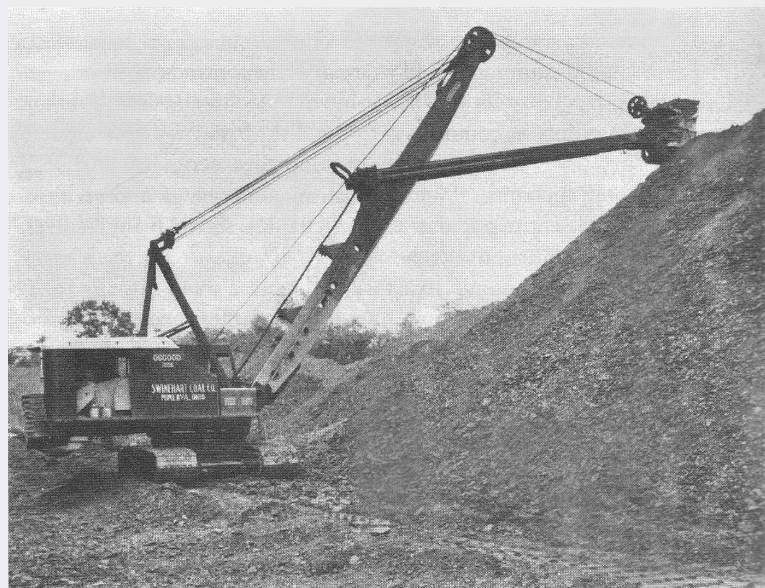
Source: Osgood General photo in Herbert L. Nichols, Jr., Moving the Earth: The Workbook of Excavation *(Greenwich, CT: North Castle, 1955).*

In classic fashion, the disruptive products looked crummy to the customers in the inner circle—the mining, general excavation, and sewer contractors who needed big holes dug and therefore needed the cable machines. Instead of targeting these customers, the entrant hydraulic firms smartly went after nonconsumers. The firms sold their excavators to small, residential contractors as attachments to small industrial and farm tractors that could be used to dig narrow ditches for water and sewer lines and foundations of houses under construction. To people who had always dug these holes by hand because the big, imprecise cable-actuated shovels were too expensive for their needs, the fact that the hydraulic backhoes, as they became known, had small capacities was just fine. They could dig the foundation of a house in less than an hour and were much more precise than were the cable excavators, which worked well for the jobs at hand.

In short, the metric of performance about which the customers for hydraulics cared was different from that of the cable excavator customers. The latter valued sheer capacity whereas the hydraulic customers—such as the contractors who wanted to dig narrow, shallow trenches— valued width and the speed and maneuverability of the tractor on which the hydraulic excavator could be mounted. The story of disruption was, in some senses, relatively straightforward from here, as the hydraulic excavating technology improved year after year and could handle more and more capacity. By 1965, the shovels could hold 2 cubic yards of earth. As they became good enough to dig bigger holes, customers who needed the greater capacity migrated to the outer circle, delighted to switch because the hydraulic machines were much more reliable and less prone to breakdowns than their cable-actuated peers. Over time the hydraulic excavators

Figure 5. Hydraulic backhoe manufactured by Sherman Products
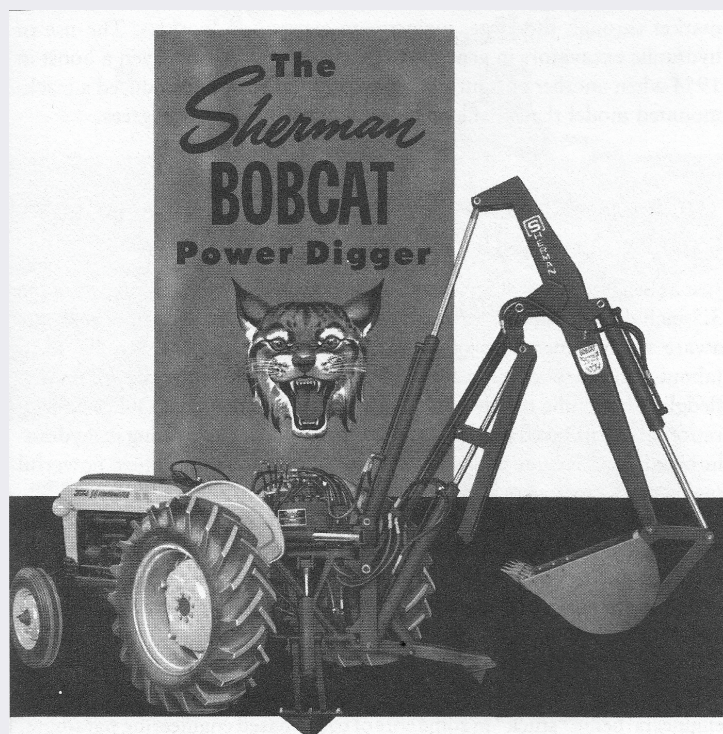
Source: Brochure from Sherman Products, Inc., Royal Oak, Mich., early 1950s.

transformed the industry and replaced the cable excavators—and the majority of the cable excavator companies disappeared.*

As a closer look into the story reveals, however, it wasn't quite so straightforward while it was actually unfolding. Several of the established cable-actuated excavator companies who lost out in the end actually tried to adopt the hydraulic technology, but they did so as a sustaining innovation.

The first to make the effort, Bucyrus Erie, introduced a new product in 1951 that utilized hydraulics. But it didn't just use hydraulics. Called the "Hydrohoe," it was literally a hybrid, as it used hydraulics as well as a cable mechanism. As the early Hydrohoe product brochure in *Figure 6* shows, Bucyrus Erie marketed this hybrid to its existing customers by talking about its big capacity and reach. In other words, it attempted to use the hydraulic technology to improve its existing cable-actuated excavators. Although the Hydrohoe was not a big success, it was on the market for over a decade. Several other established cable excavator companies also introduced hydraulic shovels in the 1960s. Nearly all were hybrids and were designed to improve the performance of their products in the inner circle. Engineers created extremely innovative solutions in many cases to do just this. Ultimately, however, the pure disruptive hydraulics won out and transformed the sector.

This phenomenon of the leaders utilizing the new technology in a hybrid state to support the traditional system is not at all aberrant, and often the hybrid form lasts for quite a while. We see this behavior in sector after sector, and—as we'll see from the examples in the following accounts of steamships, electric cars, digital photography, online retail, and online banking—it happens for predictable reasons.

The hybrid of steam and sails in ships

Today it's easy to think of steam power as a sustaining innovation for ships relative to sails, but when it first emerged, it wasn't anything of the sort. Steam power was quite limited.

When the first commercially successful steamship traveled on the Hudson River in 1807, it underperformed transoceanic sailing ships on nearly every dimension of performance.[8] It cost more per mile to operate; it was slower; and it was prone to frequent breakdowns. It was a classic disruptive technology relative to sails. Though not suitable for transoceanic travel, steamships were ideal for rivers and lakes, where the ability to move against the wind or in its absence was

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* Even today, the cable-actuated excavator technology has a longer reach and greater lift than hydraulic excavators. Both technologies have improved along parallel technology trajectories, but once hydraulic excavators became good enough to do the jobs customers needed done on these dimensions, the customers began evaluating their options according to different criteria.

NOW...
a completely hydraulic dragshovel

THE H-3 Hydrohoe

Another BUCYRUS ERIE "FIRST"
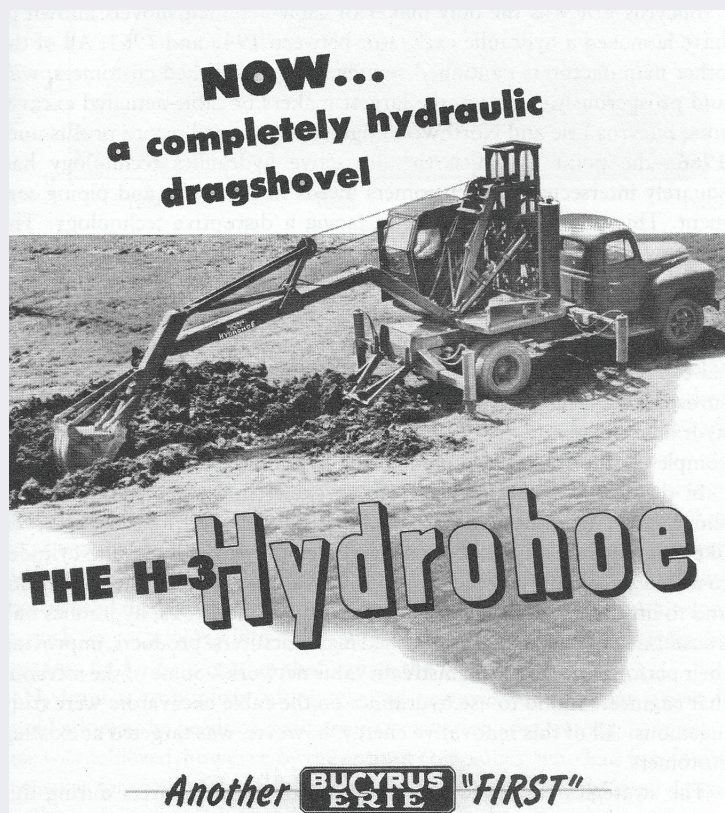
Source: Brochure from Bucyrus Erie Company, South Milwaukee, Wis., 1951.

quite important. In this context, steam outperformed sails.

What happened may sound like a broken record. New companies emerged that built steam-powered ships while existing wind-powered ship companies continued to focus on and improve their existing businesses. Ultimately, by the early 1900s, the steam-powered ships became good enough for transoceanic travel. Customers migrated from the inner circle to the outer circle, and every single sailing ship company went out of business.

Once again, however, the wind-powered ship companies did not completely ignore the steam power; it was just that the only place they could even think about using the technology was in their mainstream market.

The first transoceanic ships with steam power were actually outfitted with both steam engines and sails. In 1819, the hybrid vessel *Savannah* made the first Atlantic crossing powered in part by steam; in truth, only 80 hours of the 633-hour voyage were by steam rather than sail.[9] Transoceanic wind-powered ships such as the *Savannah* incorporated steam power as a sustaining innovation in a hybrid form. Steam power imparted some important advantages, but because it was not reliable, having sails as a backup was critical. The wind-powered ship companies never made a true attempt at entering the pure disruptive steamship market—and they ultimately paid the price.

The reason was not that the sailing ship companies didn't know about steam power or even see the technology's potential. The problem was that their customers, who were transoceanic

shippers, could not use steam-powered ships until the turn of the century. To embark upon the disruptive innovation of steamship building, the sailing-ship makers would have had to change their business model entirely to prioritize the inland waterway market, because that was the only place where steam-powered vessels were valued throughout most of the 1800s. Focusing on inland waterways did not make sense, from their point of view, when they had the opportunity to build bigger and better ships for transoceanic travel that offered far more profits and prestige.

The hybrid of gas and electric in cars

The same basic story is taking place today in the automobile sector. Electric engines represent a disruptive innovation relative to gasoline-powered engines. Electric-powered cars travel a shorter range on a single charge, and they can't go as fast as their gasoline-powered counterparts. Using the theory of disruptive innovation, we can predict with some certainty that those manufacturers trying to pioneer electric cars to compete directly with gasoline-powered ones in the mainstream and high end of the market are fighting an uphill battle for market share that they can't win. The best place to launch pure electric vehicles will be in places of nonconsumption where their limitations are valued—such as in senior citizen communities or as a product for teenagers whose parents don't want them driving fast or far.

But the electric engine is already having an immediate impact on the industry—as a hybrid. Toyota's hot-selling Prius was among the first hybrid cars in the market, and the battery-powered engine combined with the gasoline-powered one has made a significant impact on the industry with a dramatic sustaining innovation to allow drivers to enjoy substantially more mileage and horsepower in their cars. Although we might predict that, broadly speaking, pure electric vehicles will ultimately disrupt the car industry, hybrid vehicles will likely sustain gasoline-powered cars— and the companies that build them—for some time to come.

Hybrids in other industries

Photography has gone through its own hybrid phases as well. Although the story of the disruption of film by digital is well known, that there have been hybrid phases is less so. For years, for example, photography companies prospered by selling photographic printer paper to customers with digital cameras who no longer needed to drop off their film at a store to be developed, and photo and convenience stores thrived by offering customers a quick way to print out their digital photos. The pure disruption of digital has only manifested itself clearly in more recent years, as cameras have been combined with phones such that few people carry standalone cameras with them and most people now share seamlessly their photos through social-networking sites such as Facebook and Instagram, where they can view them on demand from virtually anywhere.[10]

The disruption is massively transforming the photo industry, as it creates an entirely new value network in which the industry operates.

Similarly, although online retail has been disruptive to brick-and-mortar retail stores, the traditional brick-and-mortar stores have used the Internet to create "bricks-and-clicks" retail—a classic hybrid solution designed to sustain and improve how they currently operate. The disruptive online retailers, however, are steadily gaining ground and making the online experience better and better. Interestingly, one way that some online retailers are improving and gaining ground is by opening brick-and-mortar stores whose primary purpose is to serve as showrooms for online items and therefore carry limited inventory. Bonobos, a men's apparel store that was once dogmatic about only selling online, opened six brick-and-mortar stores in 2012. The stores carry limited inventory and employ only a few salespeople. This phenomenon of a pure disruption incorporating an element of an old technology—but not the old technology in its full form— is an example of disruption's upward march; after getting a foothold by launching among nonconsumers and those with the lowest performance needs, companies on a disruptive path pursue sustaining innovations—such as retail showrooms—to allow them to climb upmarket by doing more jobs in the lives of more demanding customers. This same phenomenon is occurring in K–12 education, as we will see.[11]

Online banking has also emerged as a disruptive innovation, but for a couple decades now, it has not wiped out branch banking. Indeed, established branch banks have used online banking as a sustaining innovation to offer their existing customers a better service—yet another hybrid solution. Given the rise of ATMs in the 1960s before online banking, many might have predicted a quick demise of branch banks, but that hasn't happened. Instead, branch banks have remained for decades now, as it turns out that for a great many customers, they perform valuable jobs related to handling paper currency and coins, which are still very much a part of the established commercial system. Disruptive innovation theory predicts that in the long term, if pure electronic and mobile payments substitute completely for paper money, then at that point branch banks will become obsolete (or at least the bank teller aspect of them), as a completely new value network will disruptively replace the existing value network. As we'll see, this provides a powerful analog for what is taking place in K–12 schooling.

Why do hybrids happen?

Incumbent firms create hybrid products for predictable reasons. From a business-model point of view, the pure disruptive technology does not make sense at first to the managers at the leading companies. In the case of excavators, Bucyrus Eerie saw hydraulic machines coming. But its existing customers did not need them and could not use them. Bucyrus Eerie was caught in a fierce competitive battle against at least 20 other manufacturers, and if it had steered its limited resources away from next-generation cable-actuated excavators to focus on hydraulic excavators, it would have lost market share.

Furthermore, developing bigger, better, and faster cable excavators to steal share from existing competitors constituted a much more obvious opportunity for profitable growth.[12] Why make pure hydraulic machines that sold for smaller profits and were useless to their main customers when Bucyrus Eerie instead could offer a "best of both worlds" machine to sell to its most important, profitable customers?* The development of hybrids is a natural, predictable response to the innovator's dilemma.
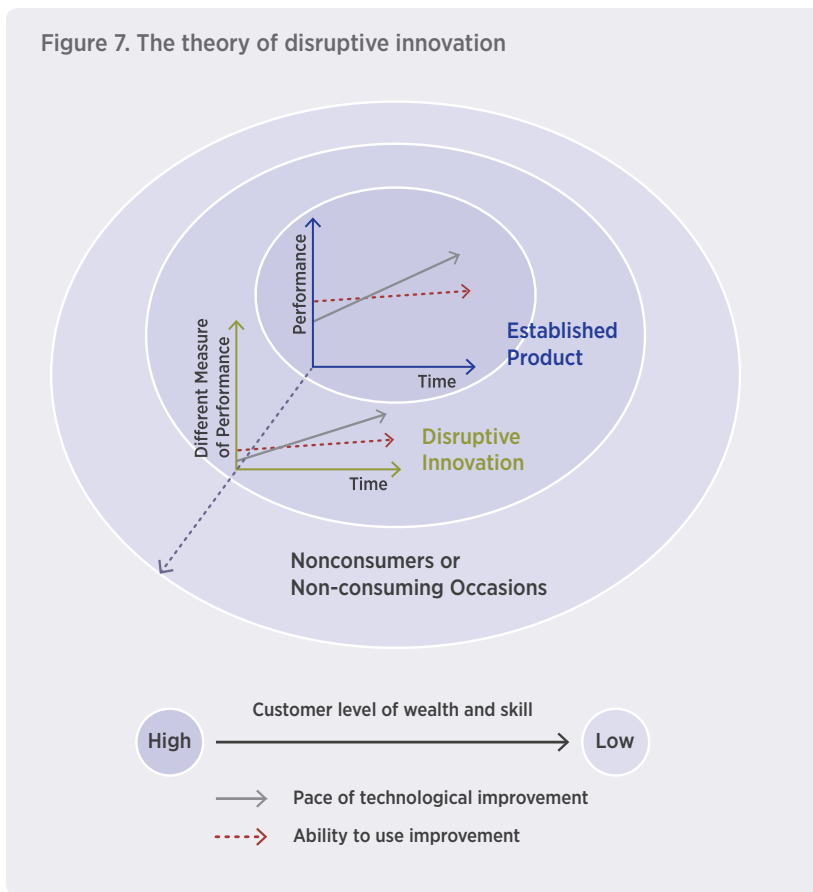
How to spot a hybrid

Hybrid innovations are easily mistaken for disruptive innovations for the simple reason that both contain the disruptive technology. The Bucyrus Eerie Hydrohoe had a hydraulic system, hybrid ships had steam engines, and hybrid cars have electricity-powered engines. An observer could easily conclude that each of these innovations was disruptive.

But innovations need more than the new technology to qualify as disruptive; they must also have a disruptive business model. This is where hybrids are distinct. Their business models follow the pattern of *sustaining innovations*. They enter the market to serve existing customers in the inner circle better, as depicted in *Figure 7*, along the initial definition of performance. Meanwhile, disruptive innovations enter the market to serve nonconsumers, depicted in the outer rings of Figure 7, or those who are overserved by the existing products. The disruption gets better and better and eventually becomes good enough to attract mainstream customers from the inner circle.

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* If an organization tries to deploy a pure disruption in the mainstream market, the only way it can survive is if it receives eternal subsidies. The venture capital firm, Kleiner Perkins Caufield Byers (KPCB), provides a case in point. With much fanfare, in 2008 it established its Green Growth Fund as a $1 billion initiative to invest in and support later-stage greentech ventures. Many of the companies in which it invested that deployed pure disruptions in established markets appeared to be profitable—but the top line was filled largely with subsidies. As the subsidies have fallen away piece by piece, so too have several of the companies in which it invested.

Figure 7. The theory of disruptive innovation

Performance

Different Measure
of Performance

Time

Established
Product

Time

Disruptive
Innovation

Nonconsumers or
Non-consuming Occasions

Customer level of wealth and skill

High → Low

→ Pace of technological improvement

----> Ability to use improvement

The distinction between sustaining and disruptive strategies is critical because organizations that are innovating only along the sustaining trajectory lose when a disruptive battle comes along. In any given market, sustaining innovations serve a different purpose from those that are disruptive and affect the future of an industry in a predictably different way.

Fortunately, the pattern of hybrids across industries offers a guidepost to differentiate between them and pure disruptions. We can distill at least four characteristics of hybrids that are consistent across the history of excavators, steamships, electric cars, photography, personal computers, retail, and banking:

1. Hybrid innovations include both the old and new technology, whereas pure disruptions do not offer the old technology in its full form. *Table 1* summarizes examples of this characteristic in hybrids across several industries.

2. Hybrid innovations target existing customers, rather than nonconsumers or those who are overserved by the incumbent technology. *Table 2* provides examples of this characteristic from several industries.

3. Hybrid innovations try to do the job of the incumbent technology. As a result, the performance hurdle required to delight the customers is quite high because the hybrid must do the job at least as well as the incumbent product on its own, as judged by the original definition of performance. In contrast, companies that succeed at disruptive innovations generally take the capabilities of the new technology as a given and look for markets that will value them for what they are. *Table 3* describes how hybrids and pure disruptions differ relative to this characteristic.

4. Hybrid innovations tend to be less "foolproof" than disruptive innovations. They do not reduce the level of wealth and/or expertise needed to operate them. ***Table 4*** provides examples from several industries.

The four characteristics described in this section provide markers for identifying hybrid innovations in other sectors. They help distinguish a hybrid technology or model from one that is purely disruptive.

Table 1. Hybrid innovations include both the old and new technology

HYBRIDS			PURE DISRUPTIONS
Example	**Old technology**	**New technology**	
Hydrohoe excavator	Cables to lift the shovel	Hydraulic cylinders to curl the shovel into the earth and draw it toward the cab	Excavators with only hydraulic cylinders
Early steamships	Sails	Steam engines	Riverboats that only use steam, not sails
Hybrid cars	Gasoline-powered engine	Electricity-powered engine	Cars with only electric engines, no gasoline tanks
Hybrid photography system	Photo printing paper and brick-and-mortar printing stations	Digital cameras and editing software such as Adobe Photoshop	Digital cameras coupled with digital photo-sharing solutions such as Instagram
Bricks-and-clicks retail	Brick-and-mortar store	Online store	Standalone online stores such as Amazon.com
Hybrid banking	Brick-and-mortar branch offices	Online transaction services	Mobile wallet services such as Tagattitude and Turkcell

Table 2. Hybrid innovations target existing customers

HYBRIDS		PURE DISRUPTIONS
Example	**Initial customers**	**Initial customers**
Hydrohoe excavator	General contractors and miners. Bucyrus Eerie labeled the Hydrohoe a "dragshovel," showed it pictured in an open field, and claimed it could get "a heaping load in every pass"—all aimed at appealing to their existing customers.[13]	Residential contractors who were digging trenches by hand
Early steamships	Transoceanic customers	Inland waterway shippers who could not sail when the wind was against them
Hybrid cars	Existing car owners. The top hybrid car, the Toyota Prius, serves mainstream customers and uses the established commercial system of dealers, roads, and service stations.	Senior citizens and teenagers who are overserved by most mainstream automobiles
Hybrid photography system	People who still want printed photos just as they did in the days of film	People who do not bother to print out photos at all
Bricks-and-clicks retail	Customers who want to try out and buy products in the store but also have online access	Customers without access to certain goods in a local brick-and-mortar store. Amazon.com began as a bookstore to offer millions of book titles to nonconsumers—people who were limited to whatever their local brick-and-mortar bookstore carried.
Banks with online banking	Customers who want to pay their bills and transfer funds online as well as have access to their traditional branch banking services	People in developing countries who have no access to traditional banks. Mobile banking and payments are a welcome innovation.

Table 3. Hybrid innovations try to do the job of the incumbent technology

	HYBRIDS		PURE DISRUPTIONS
Example	**Evidence of trying to do the job of the incumbent technology**	**Incumbent performance hurdle**	**Initial markets with different performance hurdle**
Hydrohoe excavator	Bucyrus Eerie spent over a decade trying to make the Hydrohoe good enough for general excavation customers.	Large scoop capacities and long reaches	Entrant firms found that small residential contractors were delighted with the small capacities and short reaches of pure hydraulic machines.
Early steamships	The makers of sailing ships only partially embraced steam power but spent most of their efforts on improving sails, which worked better for transoceanic voyages.	Reliability and affordability on long oceanic journeys	Entrant firms found that ship captains of inland waterways greatly valued steam power even in its rudimentary form because it helped them move without wind.
Hybrid cars	Toyota markets the Prius as a way for the typical driver to get better mileage.	Fast acceleration, ability to go long distances without refueling, horsepower	Entrant firms have found that pure electric golf carts delight seniors because the carts do not accelerate too fast and it is just fine that they can't travel long distances.
Hybrid photography system	Kodak markets its Picture Kiosks as a way for photographers to have the best of both worlds—digital photography and lovely prints.	Printing quality and options, such as the ability to print photo books, calendars, and greeting cards	Entrants like Instagram look for markets of consumers who do not want to bother with prints and are delighted by an easy way to share their photos digitally.
Bricks-and-clicks retail	Retailers market their bricks-and-clicks solutions as the best of both worlds.	Face-to-face service plus online convenience and assortment	Jeff Bezos chose the name "Amazon" for his purely online marketplace because he liked that it referred to a place that was exotic and different. His idea caught on among shoppers who valued selection much more than the ability to touch and feel a product before purchase.
Banks with online banking	Major banks with brick-and-mortar branches offer online banking as a convenient add-on for customers who want to do paper-based transactions at a physical bank.	Face-to-face service plus online convenience	Millions of poor people in developing countries use clunky mobile phones to make payments as a practical alternative to cash and bank accounts.

Table 4. Hybrid innovations tend to be less foolproof than disruptive innovations

INDUSTRY	EVIDENCE THAT HYBRID REQUIRES MORE WEALTH AND/OR EXPERTISE
Excavators	The sheer size of the Hydrohoe and other cable-actuated machines made them much more difficult to maneuver than hydraulic excavators, which could attach easily to the back of farm tractors, required little expertise to use, and were more affordable.
Steamships	Whether a sailing ship or steamship is more complicated to operate is a matter of debate. But a hybrid of the two, such as the *Savannah,* was the most complicated of them all because it required expertise in both.
Automobiles	Hybrid vehicles are not necessarily more complicated to operate than pure electric vehicles, but they do not offer the cost advantages of electrics that are introduced disruptively (not all are introduced disruptively) and require more wealth to purchase.
Photography	Print-based photography requires dealing with printers and ink cartridges or paying for a third party to do the printing. Digital photo sharing eliminates all these tasks and costs.
Retail	Hybrid retailers must pay for floor space and face-to-face salespeople while also operating the website. Online retailers have a less expensive and simpler cost structure because they eliminate the traditional store requirements.
Banking	Like purely online retailers, mobile wallets eliminate the need for any front-of-bank services, whereas hybrid banking retains those costs.

HYBRID MODELS OF BLENDED LEARNING

The track record of hybrids in other industries is illuminating to the study of blended learning. The examples show that when a disruptive technology emerges, the leading firms in the field often attempt to adopt it, but they tend to do so as a *sustaining innovation*, generally by creating a hybrid solution that marries the old technology with the new to create something that performs better along the initial definition of performance to serve their existing customers. This sustaining innovation is critical to improve the existing product. At the same time, however, because the leading companies choose a sustaining rather than disruptive strategy, in the end they are generally left behind as the pure disruption becomes good enough along the original definition of performance to pull in the customers from the original market. When the disruption reaches this point of becoming good enough, customers are delighted to abandon the original market for the sake of the new benefit—or value proposition—that centers around things such as convenience, affordability, simplicity, and accessibility.

We saw this with Bucyrus Eerie, which could have pursued a disruptive strategy by finding a market for its excavators that would value the pure hydraulic technology for what it was—smaller, simpler, and more maneuverable. Instead, the company opted for the sustaining strategy of marketing the Hydrohoe, a hybrid machine that would allow it to introduce hydraulics to its existing customers while continuing to deliver the performance that the cable-actuated machines offered. As a result, it missed the larger disruption that eventually transformed the industry, as pure hydraulic technology eventually became good enough to meet the needs of mainstream excavators and miners.

In the world of education, those interested in bringing online learning to the schoolhouse have two options as well. The analogy goes like this: online learning is like hydraulics, and the traditional classroom is like the old cable-actuated system. The *sustaining* option is to invent a hybrid solution that gives educators "the best of both worlds"—that is, the advantages of online learning combined with all the benefits of the traditional classroom. The *disruptive* option is to deploy online learning in new models that depart from the traditional classroom and initially target nonconsumers who value the new technology for what it is—more customizable, affordable, and convenient. Whether something is sustaining or disruptive is significant because, in the end, disruptions almost always become good enough to meet the needs of mainstream customers who, delighted by the new value propositions they deliver, adopt them. In other words, the disruptive models almost always supplant the sustaining models over the long term.

Importantly, although many areas of nonconsumption exist at the classroom level, little nonconsumption exists at the school level in U.S. K–12 education. Almost every student has access to a government-funded school of some sort. Consequently, we are not seeing online learning disrupt schools or districts at this point. As referenced earlier, when there is no nonconsumption, a hybrid solution is the only viable option for a new technology that underperforms the old on the traditional measures of performance. As we will see, this means that although online learning will likely disrupt the traditional *classroom*, the hybrid solution of blended-learning *schools* will likely be the dominant model of schooling in the United States in the future.*

> The disruptive option is to deploy online learning in new models that depart from the traditional classroom.

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* In developing countries where there is rampant nonconsumption of school, in the long run it is quite conceivable that innovations that are not of a hybrid nature will disrupt schooling as we know it. It is also likely that a hybrid solution will not be the dominant model in higher education in the United States in the long term because there remain big pockets of nonconsumption.

The hybrid zone of blended learning

In 2012, the Institute published a white paper titled, "Classifying K–12 blended learning," which categorized the majority of blended-learning programs emerging across the K–12 sector today. The primary models we continue to see in the field fall into four categories:

- The **Rotation model** is one in which within a given course or subject (e.g., math), students rotate on a fixed schedule or at the teacher's discretion between learning modalities, at least one of which is online learning. Other modalities might include activities such as small-group or full-class instruction, group projects, individual tutoring, and pencil-and-paper assignments. The Rotation model has four sub-models: Station Rotation, Lab Rotation, Flipped Classroom, and Individual Rotation.

    - The **Station Rotation model**—or what some refer to as the Classroom Rotation or In-Class Rotation model—is one in which students rotate within a contained classroom.

    - The **Lab Rotation model** is one in which the rotation occurs between a classroom and a learning lab for online learning.

    - The **Flipped Classroom model** is one in which the rotation occurs between the school for face-to-face teacher-guided practice (or projects) and the home or other off-site location for online content and instruction.

    - The **Individual Rotation model** differs from the other Rotation models because each student in essence has an individualized playlist and does not necessarily rotate to each available station or modality.

- The **Flex model** is one in which online learning is the backbone of student learning, even if it directs students to offline activities at times. Students move on an individually customized, fluid schedule among learning modalities, and the teacher of record is on-site.

- The **A La Carte model** is one in which students take one or more courses entirely online with an online teacher of record and at the same time continue to have brick-and-mortar educational experiences. Students may take the online courses either on the brick-and-mortar campus or off-site.

- The **Enriched Virtual model** is a whole-school experience in which within each course (e.g., math), students divide their time between attending a brick-and-mortar campus and learning remotely using online delivery of content and instruction.

The taxonomy is still imperfect and will continue to evolve along with the field. But for now, it offers a starting point for differentiating between sustaining and disruptive models of blended learning.

FOUR CHARACTERISTICS OF AN INNOVATION INDICATE THAT IT IS IN A HYBRID STAGE:

1. It includes both the old and new technology, whereas pure disruptions do not offer the old technology in its full form.

2. It targets existing customers, rather than nonconsumers or those who are overserved by the incumbent technology.

3. It tries to do the job of the incumbent technology. As a result, the performance hurdle required to delight the customers is quite high because the hybrid must do the job at least as well as the incumbent product on its own, as judged by the original definition of performance. In contrast, companies that succeed at disruptive innovations generally take the capabilities of the new technology as a given and look for markets that will accept them.

4. It tends to be less "foolproof" than disruptive innovations; it does not significantly reduce the level of wealth and/or expertise needed to operate it.

Figure 8 summarizes the four elements of the hybrid pattern that we will use to identify blended-learning models that have the characteristics of a hybrid technology.

Figure 9 highlights the blended-learning models that are following the pattern of a hybrid innovation. The models that fall within the *hybrid zone of blended learning* possess both the old technology (the traditional classroom) and the new technology (online learning). When viewed through the lens of disruptive innovation theory, these models appear to be sustaining innovations relative to the traditional classroom.

As Figure 9 illustrates, most of the subcategories of the Rotation model fall within the hybrid zone of blended learning.

Figure 9. Hybrid zone of blended learning
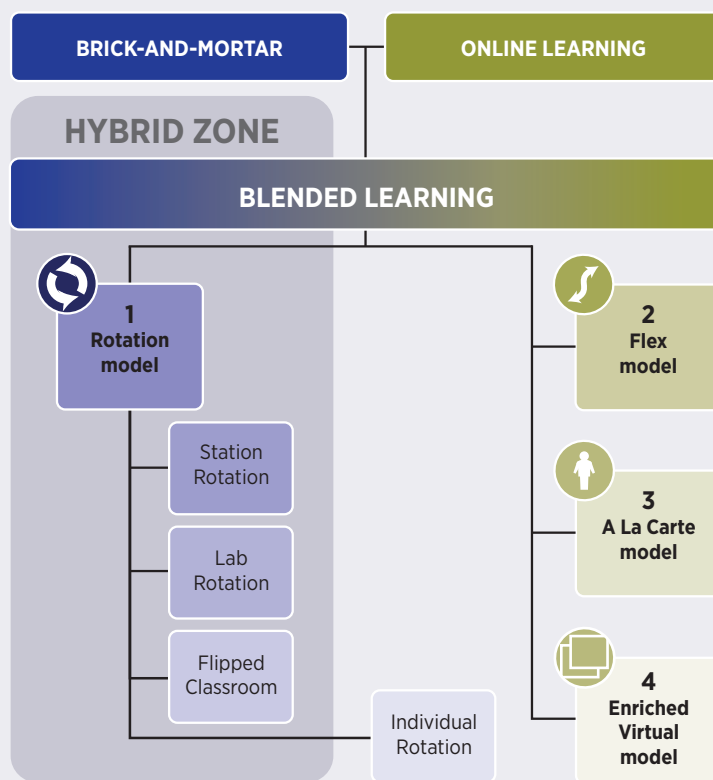
Blended-learning programs are classified as Rotation models if they involve students within a given course or subject rotating *on a fixed schedule or at the teacher's discretion* between learning modalities, at least one of which is online learning. Other modalities might include activities such as small-group or full-class instruction, group projects, individual tutoring, and pencil-and-paper assignments. This design, as implemented in the Station Rotation, Lab Rotation, and Flipped Classroom variants, satisfies the four markers of a hybrid:

1. It represents an intergenerational combination of the old and the new. It preserves or only modestly tweaks the rough contours of facilities, staffing, and school operations found in the traditional model.

2. It is largely designed for existing students taking core subjects in mainstream classrooms. In fact, rotations have been a classic feature of mainstream classroom design for decades, particularly at the elementary school level. The blended-learning version merely adds one or more online components to the rotation. Furthermore, most programs in our research are using rotations for core subjects like math and reading, not to provide access to otherwise unavailable subjects.

3. It preserves the job of the traditional classroom because it keeps students in their seats in the classroom for the prescribed number of minutes. Meanwhile, the design harnesses online learning to sustain the traditional classroom by helping the classroom perform better along the original definition of performance for its existing customers.

4. It is not noticeably simpler or more foolproof than the existing system. On the contrary, in many cases it appears to require all the expertise of the traditional model *plus* new expertise in managing digital devices and in integrating data across all the supplemental online experiences in the teacher-directed rotation.

The first three sub-categories of the Rotation model all have hybrid characteristics. The first sub-category is the Station Rotation model, whose basic classroom design revolves around the same concept of station rotation that has existed in primary schools for decades. For example, KIPP Empower Academy, which in the 2012–13 school year served roughly 330 kindergarten through second-grade students in South Los Angeles, places its students into heterogeneous, 28-student classes. Throughout the day the students rotate on a fixed schedule among online learning, small-group instruction with Lead Teachers, and small-group instruction with Intervention Teachers.[14] This design facilitates a marginal increase in the student-teacher ratio, but the traditional structure of age-based cohorts, the number and size of classrooms, and the role of face-to-face instruction remain largely intact.

Similarly, the Lab Rotation model starts with the traditional classroom and then adds a rotation to a computer or learning lab. Lab Rotations often drive operational efficiency and

facilitate personalized learning, but they do not replace the emphasis on traditional instruction in the classroom. For example, currently at Rocketship Education,[15] which in 2012–13 had seven schools serving 3,800 K–5 students in San Jose, Calif., up to four classes of students together cycle into a Learning Lab for 100-minute blocks. They spend 60 to 80 minutes of that time engaged in self-directed online learning under the supervision of a team of five Individualized Learning Specialists. The students cycle to other classrooms for literacy, social studies, math, and science instruction with face-to-face teachers. The rotation to Learning Labs allows Rocketship to save roughly $500,000 per school each year in traditional school expenditures, which it can then spend on other parts of its model.[16] Many people attribute the strong academic gains at Rocketship schools to the blended-learning model. The model does not dispense with traditional face-to-face instruction in classrooms, however, nor does it define performance in a new way,

> The Station Rotation, Lab Rotation, and Flipped Classroom models introduce a hybrid solution that marries the traditional classroom with online learning.

such as simplicity or convenience. Instead, it harnesses online learning as a sustaining innovation to help the traditional classroom stretch to meet better the needs of its existing students along the dimensions of performance that society has historically valued for inner-city charter schools in California.*

The third Rotation model with hybrid characteristics is the Flipped Classroom. Although teachers are implementing it in different ways, in general the Flipped Classroom is emerging as a technique that traditional teachers can use to improve student engagement. For example, at Stillwater Area Public Schools along the St. Croix River in Minnesota, students in math classes in grades 4–6 use Internet-connected devices after school—usually from home—to watch 10- to 15-minute asynchronous instruction videos and complete comprehension questions on Moodle. At school they practice and apply their learning with a face-to-face teacher. This model does not transform school operations or upend the traditional attributes of the classroom, including

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* Although the Lab Rotation model is a sustaining innovation relative to the traditional classroom, we suspect that blended-learning charter schools such as Rocketship are disruptive relative to traditional "No Excuses" charter schools. Schools like those in the Rocketship network are using human-capital innovations—such as the use of Learning Labs with online stations and paraprofessionals, which reduces the need for one certified teacher per grade and then creates funding to have a chief academic officer supporting teachers at each school—to realize improved test scores and significant reductions in traditional school expenditures. Unlike many top charter schools, which have costs above what the public funds and therefore rely on a significant dose of philanthropic funding, Rocketship schools do not require philanthropy for their day-to-day operations. In this way, Rocketship and other charter networks that are leveraging blended learning to improve radically their cost structure appear to be low-end disruptions relative to traditional charter schools.

age-based cohorts, typical bell schedules, or basic facility design. Instead, it makes better use of its existing teachers and classrooms to deliver sustaining performance improvements to its mainstream students.[17]

Indicative of their sustaining nature, the Station Rotation, Lab Rotation, and Flipped Classroom models can all be implemented without major revisions to the resource allocation or other processes already in place at a school. None of the models generally requires a complete overhaul of physical facilities or staffing. Each introduces a hybrid solution that marries the traditional classroom with a new technology—online learning—to create something that performs better along the initial definition of what a good classroom is meant to do.

Disruptive models of blended learning

In contrast, the Flex, A La Carte, and Enriched Virtual models, as well as the Individual Rotation model, all have the potential to be disruptive relative to the traditional classroom. Just as Bonobos is improving itself to serve more-demanding customers by opening brick-and-mortar stores that carry limited inventory and whose primary purpose is to serve as a showroom for online items, rather than a fully functioning traditional store, all of these models represent instances of online learning adding a brick-and-mortar component so as to improve for more-demanding users who need face-to-face services. The models generally differ from the hybrid pattern in the following ways:

1. They offer the new technology (online learning), but they offer very little that resembles the old (the traditional classroom). Their facility requirements, bell schedules, staffing, and other operations differ significantly from the traditional model.

2. Most of the earliest examples we have found of these models got their start by serving pockets of nonconsumption. Many of the first Flex programs were focused initially on dropout and credit recovery. Most A La Carte programs came about to serve students who otherwise did not have access to courses such as Advanced Placement and foreign language offerings. The various Enriched Virtual programs emerged mostly to provide more support for students enrolled in full-time virtual schools—as well as to accommodate families who wanted full-time virtual schools but who lived in states that prohibited them. Individual Rotation programs are still rare, but will likely emerge at scale outside the mainstream classrooms of district schools at first.

3. These models are not focused on the job of keeping students in their seats for the prescribed number of minutes.[18] The opposite is in fact true. The models excel at allowing students to move through content at their own pace and making time-in-seat completely variable. They compete against a different performance hurdle from the traditional classroom. Their strength is in the way they allow students to control time, path, pace, and in some cases, place.

4. These models are more "foolproof" in some sense than the first three Rotation models because, in the former, the Internet tends to serve as the backbone for student learning. As long as the devices and connectivity are working, students can access learning opportunities. Face-to-face adults are, of course, critical for providing mentoring, support, and often the application of knowledge for deeper learning and higher-order skills, but these models diminish the students' total dependence on them for managing their learning.

Let's consider these models one at a time. The Flex model characterizes a program in which online learning is the backbone of student learning, even if it directs students to offline activities at times. Students move on an *individually customized, fluid schedule* among learning modalities, and the teacher of record is on-site. The teacher of record or other adults provide face-to-face support on a flexible and adaptive as-needed basis through activities such as small-group instruction, group projects, and individual tutoring. Some implementations have substantial face-to-face support, whereas others have minimal support.

Students in Flex programs have no need for age-based cohorts because all are moving through courses and modules at their own paces and on their own schedules. For example, AdvancePath Academics co-locates Flex-based learning academies on high school campuses to serve youth who have dropped out of the system. The provider asks districts for roughly 3,000 square feet of space, which it redesigns into a large computer lab, an offline reading and writing zone, and an area for small-group instruction. The academy sessions are four hours long, five days per week. AdvancePath Academics uses Apex Learning for its core curriculum, American Education A+ for non-core curriculum and electives, and some ALEKS Math and Achieve 3000 for specific learner needs. Students move through the content at their own pace, and face-to-face teachers intervene as necessary.

Like many Flex programs, AdvancePath Academics got its start by serving nonconsumers—students who had dropped out of school. No district in America has transformed the classroom for *every* student in its system by universally knocking down walls, installing computer labs, and redefining the teacher role. But 11 districts have been delighted to turn over a meager 3,000 square feet and their dropout population to AdvancePath Academics. The labs are highly replicable and relatively simple to implement because they depend more on Apex Learning and American Education A+ for content and instruction than upon highly qualified face-to-face teachers.

> The Flex, A La Carte, Enriched Virtual, and Individual Rotation models dispense with the classroom as we know it.

Another model that has disruptive features is the Enriched Virtual model. Students in Enriched Virtual programs divide their time between learning at a brick-and-mortar location and learning remotely online. They seldom visit the classroom every weekday. That untethering from their seats has significant implications for improving facility and faculty utilization. Because of its potential for cost savings, the model could be a vehicle to create many more affordable ways for nonconsumers to access at least part of a brick-and-mortar experience—as well as for a particular school to use its building more efficiently and serve many more students.

The Enriched Virtual model is notable for how different it is from the third characteristic of hybrid innovations in Figure 8. Hybrids get their start by trying to do the job of the original technology, but do it better. In contrast, programs that fit the Enriched Virtual model generally did not begin as reform efforts to improve upon the job of the traditional classroom. Instead, most began as efforts to improve upon the services of the disruptive technology—online learning. The history of Enriched Virtual programs shows that most began when full-time virtual schools needed to add a brick-and-mortar component to improve services for online students learning from home who needed more face-to-face support. The model is illustrative of a disruptive technology improving over time.[19]

The third model with disruptive features is the A La Carte model. In this model, students dispense with the traditional classroom altogether to take online courses in addition to their traditional courses. An online teacher is the teacher of record for the online courses—although schools can certainly make this an intentional part of their strategy—and in some cases even arm students with a variety of in-person supports, like mentors in e-learning cafes. The A La Carte model is the clearest case of pure disruption. Looking just at the course itself and not at the rest of a student's experience, it often has no blended component; taken as a part of a student's full schooling experience, it represents a student engaging in blended learning. It leaves no doubt that the traditional classroom is absent from the model because for fully online courses, students do not attend a traditional brick-and-mortar classroom, even if some models offer students the ability to take the courses in cyber cafes or learning labs.[20]

Finally, the Individual Rotation model appears to be disruptive relative to the traditional classroom. It is the one Rotation model that has disruptive rather than sustaining characteristics. The Individual Rotation model is a blended-learning program in which within a given course or subject, students rotate on an *individually customized, fixed* schedule among learning modalities, at least one of which is online learning. It differs from other Rotation models because students do not necessarily rotate to each available station or modality. Some students might learn completely online if that method works best for them.

Implementing an Individual Rotation model generally requires a fundamental redesign of staffing, facilities, and scheduling. Interestingly enough, two of the most visible Individual

Rotation models—that used at Carpe Diem schools and in School of One (now called New Classrooms)—literally do away with the traditional classroom altogether and create a significantly larger open learning space as the main room for students.

Some might point out that the Individual Rotation model—with its custom playlists, dependence on digital technology, and individual schedules—is not simpler or more convenient than the traditional classroom. But whereas the model itself is quite sophisticated, students learning in this way have a much simpler, more dependable way to access high-quality content and instruction via the Internet, if that modality works best for them, instead of relying on face-to-face instructors. In that way, the model is more foolproof for students than the traditional design.

SEEING WHAT'S NEXT WITH BLENDED LEARNING

The models of blended learning that fall within the hybrid zone are on a sustaining trajectory relative to the traditional classroom. They are poised to build upon and offer sustaining enhancements to, but not disrupt, the factory-style classroom. For many education leaders, the arrival of these innovations is welcomed news. Schools that are struggling with flat or deteriorating test scores and strained budgets can find relief by harnessing the efficiencies that models such as the Station Rotation, Lab Rotation, and Flipped Classroom bring to the system. Sustaining innovation is a crucial part of any successful organization.

But the history of disruptive innovation shows that the disruptive models of blended learning are on a different trajectory from those within the hybrid zone. They are positioned to replace the classroom model and become the engines of change over the long term. There are a couple caveats to this prediction. One is that it applies to high school and, to some extent, middle school classrooms, but not necessarily to the elementary school level. High schools and middle schools have rampant nonconsumption in areas such as Advanced Placement, foreign language, and credit recovery; but these pockets of unmet demand are not prevalent—or at least have not yet been discovered in a way that stretches across the jobs that both students and schools or districts have to do—at the elementary school level. Furthermore, high school and middle school design typically features course-by-course modular architecture, which allows for modular online courses to substitute into the system more readily.

In contrast, the future of elementary schools at this point is likely to be largely, but not exclusively, a sustaining innovation story for the classroom. Outside of families that educate their children in a home-school environment, the closest that elementary schools come to presenting a disruptive path for online learning in schools is in the area of extended school hours and after-school programs. For example, Chicago Public Schools implemented a Flex model after-school program, called the Additional Learning Opportunities Initiative, to extend the school day

using laptops and paraprofessionals for grades 1–8. If elementary schools continue to face budget cuts and need to reduce the number of traditional minutes in the school day, this could create a sizable nonconsumption opportunity and disruptive foothold. But this scenario has not yet played out at this point, and so, for now, the prediction at the elementary level is unsure. Tutoring—in everything from speech therapy to English Language Learning—as well as foreign- language learning present other possible areas of nonconsumption to drive the disruption of elementary school classrooms.*

The prognosis for the disruption of the classroom at the high school and middle school levels appears clearer. It likely strains conventional wisdom, and predictably so. Whenever a disruptive innovation arrives, the established system usually views entrants in the emerging disruptive market as irrelevant to its well-being. The K–12 education sector is following suit. Flex, A La Carte, and other disruptive blended-learning models appear as only small line items on a long list of education trends and possibilities. To the extent that incumbents perceive them as a threat, they are investing significant sums trying to provide one-to-one computing and other "high-tech, high-touch" solutions or to implement a less intrusive Rotation model. An evidence of this phenomenon is the growing number of consultants who promise districts help in delivering "teacher-centric" blended learning. The focus of these efforts seems to be on co-opting a potentially disruptive technology to apply it in a sustaining way to the existing system, rather than to disrupt the system so that it becomes simpler, more accessible, and more student-centric.

In some cases, incumbents who perceive a threat are turning to legislation to make online learning go away. Their hope is that by restricting funding for online courses and reducing local flexibility around new blended-learning staffing configurations, they can stop the innovation in its tracks and shelter district schools from an uncomfortable threat. Over time, however, the disruptive models of blended learning are likely to improve enough to intersect with the needs

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* As noted earlier, when there isn't a lot of nonconsumption, there are two options for a new technology with disruptive characteristics: it can take root in a hybrid solution or it can enter a market as a pure disruption dependent on eternal subsidy to be good enough to meet mainstream needs. The hybrid models of blended learning are more likely than the disruptive models to dominate at the elementary school level because of the lack of nonconsumption at that level. This lack of a disruptive foothold makes it hard for pure disruptive models to enter the system anywhere other than to serve mainstream elementary students in core areas. Consequently, most elementary school classroom models will be hybrids that offer a "best-of-both-worlds" solution corresponding to the needs of the existing elementary school system.

of more and more students at the high school and middle school levels, despite efforts to ignore or extinguish them. When that happens, the disruptive models are on a path that will ultimately lead to their dominance over the traditional system. Any hybrid variety of blended learning is likely to fall by the wayside as the pure disruption becomes good enough over the long term, just as steam engines eventually replaced sails for transoceanic voyages and hydraulics eventually replaced cables for excavating machines.

There is a second caveat here to this prediction: the long term might be quite long. Because the disruption is emerging to a large extent within the physical architecture of existing "egg-crate" model schools, this architecture could allow the traditional classroom to harness online learning as a sustaining innovation to preserve itself for a long time to come. As with banking, given the constrained system within which schooling occurs, the transition could take longer than we might otherwise expect. That said, some have observed that once teachers taste what a Rotation model enables for their students, they are hungry to innovate more and move to models that enable even more personalized learning—although outside of a few notable examples, it is not clear how many schools have in fact made this transition. Some schools, however, are finding ways to knock down walls between classrooms to create larger spaces for Flex and Individual Rotation models with team teaching or to make do with—or slightly alter—what perhaps is a suboptimal physical architecture. As such, it is difficult to know currently how long it will take this dynamic to play itself out.

As disruptive models of blended learning do begin to transform schooling by replacing the traditional classroom, the fundamental role of brick-and-mortar schools will pivot. We suspect that schools will no longer become the primary source for content and instruction and instead focus their capabilities on other core services.

What is the future role of schools as online learning improves and snaps itself into brick-and-mortar schooling environments? Society "hires" schools to do a number of jobs, only one of which is to impart learning to students. Another central job is simply to care for children and keep them safe while parents are at work or otherwise unavailable. Schools provide important social services for many students, which range from counseling and mentoring to health services and free meals. In the years ahead, schools will likely provide more of these services, not less, for some students. From the perspective of children, having a place to have fun with friends is also vital, as is having a place to be exposed to various extracurricular activities like sports and the arts. Schools can do these jobs quite well for some students, even as other students have alternative options to fulfill them.

As online learning takes on more and more of the job of delivering content and instruction—or perhaps more and more of becoming the platform for helping determine each individual student's learning pathway, rather than in fact delivering all content and instruction—schools will

> As online learning takes on more and more the job of delivering content and instruction, it will free schools to focus on nailing other jobs.

continue to be responsible for these other jobs. In many ways the arrival of online learning is welcomed news for stressed out schools that have long been asked to do too much with too little. Once online learning becomes good enough, schools will be able to rely on it to deliver consistently high-quality instruction adapted to each student. That will free schools to focus on nailing the other jobs. These other jobs will likely include things like guaranteeing high-quality meals; clean and pleasing physical environments; the elimination of bullying; a range of athletic, musical, and artistic programs; and excellent face-to-face mentoring.

Having the flexibility to focus on non-academic matters could actually help schools improve their students' academic results. In his book *Sweating the Small Stuff*, author David Whitman calls on schools to undertake a "new paternalism" for low achieving youth. He cites examples of six "No Excuses" secondary schools that backward integrate into more of the lives of their students to fill essential holes that their families and others have neglected. Among the most important characteristics of these schools is that they are warm, caring places where teachers and principals form paternal-like bonds with students. Many of the successful brick-and-mortar schools of the future will likely be those that masterfully deliver as their core competency that type of physical environment for those children who need it and then rely on the Internet to deliver the best academic instruction.

One way this future could play out is that states could require all high school students to designate a "base school," or school of record, which would be responsible for the students' welfare, and then students could choose from a variety of modular learning options. John E. Chubb, a visiting fellow at the Hoover Institution, foresees a future in which base schools are "responsible for the student's records, credit accumulation, graduation, extracurricular activities, and overall welfare." The school could then provide blended-learning options and compete against other providers for the students' course-taking choices.[21]

IMPLICATIONS FOR EDUCATION LEADERS

The question often arises of how states, districts, and schools can participate in and even improve the evolution of the classroom, rather than watch from the sidelines. The answer is that for some educators, the most significant contribution they can make is to advance sustaining innovations within traditional classrooms. For others, the call to blaze the more disruptive path toward a student-centric system beckons. The two paths lead to different destinations, and

each is best suited to a different set of actors and circumstances. Furthermore, some leaders will find themselves managing both types of innovation simultaneously.

Steering sustaining innovation

Some educators are best positioned to be innovators who sustain the current classroom by leveraging online technologies to create powerful new hybrids to better serve students. This path is the best fit for most classroom teachers, school leaders who have limited budgetary or architectural control over their school, and those who want to improve upon where most students receive their formal education today.

There are several ways these people can implement sustaining innovations. As one example, most classroom teachers can quite simply—and without asking permission of anyone—flip their classrooms.[22] In some cases teachers could also work with others in the school, such as the principal, to upgrade the basic infrastructure in their classrooms and move to a Station Rotation model or create a basic Lab Rotation model— in essence changing the specifications for how existing components in a school fit together.[23]

Others teachers might want to redesign the fundamental architecture of their classrooms and schools as part of a sustaining innovation. In this case, they need to take advantage of the power of a heavyweight team, which is a team of people with different functional expertise from across an organization and who come together with the collective responsibility to rethink the basic architecture of a product. To be effective, members of heavyweight teams must abandon the mindset of "representing" the interests of their departments during the team's deliberations. Instead, they must think of themselves as having a unified interest in redesigning a product from start to finish.

Toyota used a heavyweight team to design the Prius hybrid car. It pulled key people from each department and put them together in a completely different location. Although they brought their functional expertise with them, their role was not to represent the interests of their departments. Rather, it was to use their expertise to generate an elegant new machine. Each component needed to interface with the others in novel ways. The engineers had to integrate all the components into a coherent whole, such that both gasoline and electricity could power a Prius.

Similarly, creating a whole-school blended-learning program can often require reconfiguring staffing, curricula, infrastructure, operations, and scheduling to integrate the online-learning component. District and school leaders who are embarking on a blended-learning implementation

> To implement hybrid learning, individual teachers can:
>
> 1) Flip their classrooms
>
> 2) Move to a Station Rotation model
>
> 3) Work with their school to create a Lab Rotation model

across the entire school will likely find that a heavyweight team is the best organizational design choice. Education Elements, a company that offers what it calls a hybrid learning management system in addition to an array of consulting services, for example, sometimes leads schools through a design process that uses heavyweight teams to help educators question all sorts of tightly held assumptions around the use of time to create blended-learning schools that generally use the Station Rotation model.

Driving disruptive innovation

Some education stakeholders have the opportunity to drive the disruption of the traditional classroom model. This path is a viable fit for schools principals—often in charters but also within districts, especially in those that have moved to portfolio models—that have some autonomy with respect to budget and school architecture. Furthermore, district leaders with authority to contract with online providers, state policy leaders, philanthropists, and entrepreneurs all are in the position to play a role in bolstering disruptive innovation.

Such leaders can take several steps, but these five seem particularly salient toward crafting an environment that fosters disruptive blended-learning models:

1. **Create a team within the school that is autonomous from all aspects of the traditional classroom.** Launching a disruptive blended-learning model requires an organizational strategy that goes beyond forming a heavyweight team. Historically, incumbent organizations have found that disruption has a paralyzing effect on them. They find that it is exceptionally difficult to reallocate resources, reshift priorities, and redesign processes to go after a disruptive opportunity that will transform their own system. To launch a disruptive model therefore within any existing school, creating an autonomous school-within-a-school—with discretion over its resources, processes, priorities, and fundamental value proposition—is critical.

2. **Focus disruptive blended-learning models initially on areas of nonconsumption.** Many of the Flex models in existence today got their start serving dropout and credit-recovery students, often as schools within schools that leave traditional classroom architecture behind. Most A La Carte opportunities began in an effort to provide courses that otherwise were unavailable to students. And many Enriched Virtual programs began to provide more scaffolding for full-time virtual-school students. Such areas of nonconsumption of the traditional classroom model provide fertile areas to begin a disruptive project without posing a threat to the incumbent system.

3. **When ready to expand beyond areas of nonconsumption, look for the students with less demanding performance requirements.** Students with strong family support

are likely to constitute an early market of people in the existing system that find that, upon securing a laptop and Internet access, they are overserved by a full day of seat time in a comprehensive high school. These students are possible first customers for disruptive models, as they represent those who have the least need for integrated services from the public education system. With strong family support, these students will likely be more capable of thriving in an environment with greater control over time, place, path, and pace. Over time, the technology will likely improve such that less advantaged students will also find it good enough and seek the disruptive options for their core schooling.

4. **Top administrators need to commit to protecting the fledgling disruptive project.** When faced with a disruptive project, organizations are innately wired to want to discount it by steering away resources to higher priority projects. The only chance for success is if a senior administrator, generally the principal or superintendent, ruthlessly defends the project and continues to feed it enough resources and grant it enough autonomy—in essence, protecting it from the natural inclination of the established system to let it fall by the wayside in deference to seemingly higher priority imperatives. The personal oversight of a senior administrator is one of the most important things a disruptive model needs to reach success.[24]

5. **Push innovation friendly policy.** States can create the conditions for the disruption of the classroom by allowing dollars to follow students down to their educational choice and moving to a policy environment that moves away from its historical focus on inputs toward one that rewards successful student outcomes, with a particular eye toward individual student growth. To empower principals and those closest to students even more to be able to create disruptive learning models, states should reimagine districts as the overseers of a portfolio of different types of schools, rather than as the managers of a set of similar "one-size-fits-all" schools. Otherwise, schools have little creative white space to pursue student-centric architectures that differ from the monolithic model.[25]

Propelling sustaining innovations, fostering disruption

Finally, other players—including philanthropists, investors, and entrepreneurs—have an ability to encourage both sustaining and disruptive innovations, and there are important reasons to foster both. Philanthropists and foundations, for example, will likely want to invest in some mix of both sustaining innovations that will have immediate impact today, as well as push the disruptive innovations that have the potential to pave the way for a student-centric education system tomorrow.

Given that disruptive innovations generally start as smaller projects and thus smaller investments, there will likely be a limited amount of money to spend on truly disruptive blended-learning innovations, which means that it may be difficult for foundations to find enough high-potential disruptive projects in which to invest. Thus, foundations should adopt a strategic plan to invest a certain percentage of their giving in sustaining innovation projects and a different percentage in disruptive projects. They should then compare decisions over whether to fund sustaining innovations against other sustaining innovations and disruptive projects against other disruptive projects as opposed to mixing everything together. Similarly, investors and entrepreneurs should be intentional in deciding to foster disruptive versus sustaining innovations. There is room—and a vital need—for both in today's education system.

In the long term, the disruptive models of blended learning are on a path to become good enough to entice mainstream students from the existing system into the disruptive plane. Their path forward, however, will not always be straight. Those employing blended learning as a sustaining innovation to the traditional classroom in the interim phase have good reasons not to throw out the old for the new right away. First, the traditional system offers a predictable value proposition that many appreciate for its creation of order and discipline around a central teacher role that is well defined. Although it is clear that teachers are critical for the success of the emerging disruptive models, their exact roles and how to do them well are not yet so clear, such that important things could be lost in a hasty transition. The second reason for not rushing over follows from this. In its infancy, a disruptive innovation's performance tends to be unreliable with significant variability. This appears to have held true in education. Some disruptive blended-learning models are outstanding; others are far from it. Finally, given that this is true and given that most schools have a limited risk tolerance because they are working with children, although fast failure in the search of successful innovation may be vital to improving schools, it is understandable that many are hesitant to prototype quickly these new models, which in turn may prevent these models from improving as rapidly as they might otherwise.

That said, the disruptive models—including those yet to be invented—promise at least three new value propositions that will accelerate the substitution of the old for the new. *Figure 10* lists some of the new value propositions that are already energizing the transformation of the sector.

First, the blended-learning models of the future promise individualization. They give students significant control over the time, place, path, and pace in which they access content and instruction. This endows students with vastly more personal agency over their learning than is possible in a traditional or hybrid classroom design. Furthermore, because they rely on online learning, which is inherently modular, disrupted classrooms are customizable; students will increasingly be able to experience school according to their own optimized learning playlists. Adaptive software with
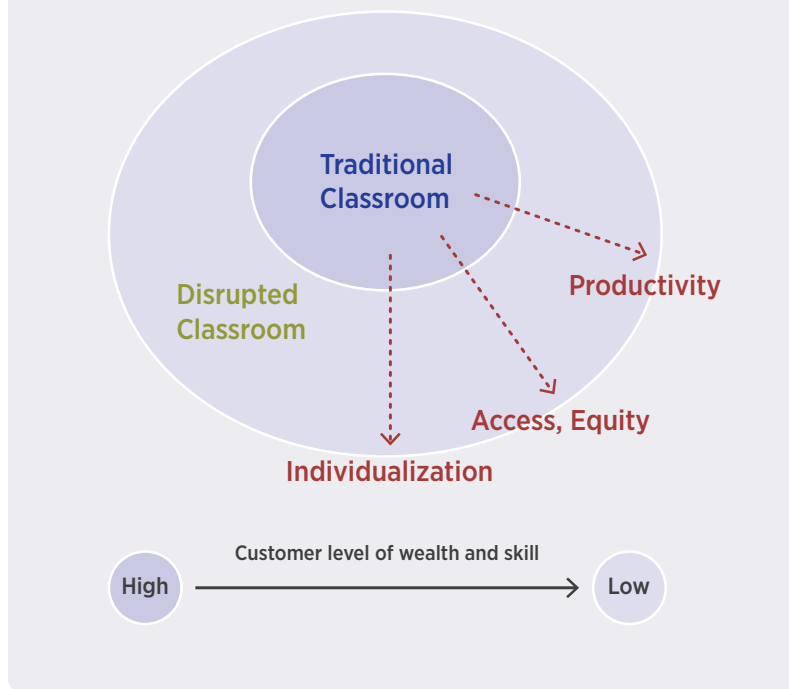
intelligent algorithms will improve over time, which will greatly facilitate, simplify, and foolproof the customization task.

Second, the disrupted classroom models of the future introduce the value proposition of universal access and equity. Students without means to avail themselves of top-tier face-to-face teachers for every course or subject will find that, because of the online delivery, their options will transcend geographic and economic barriers. As the online-learning ecosystem matures and political barriers become untenable, a noisy reshuffling will take place as students who before lived in the wrong zip code find that access to learning opportunities is no longer neighborhood defined.

Figure 10. New value propositions as online learning disrupts the way the world learns

Third, like most other disruptive innovations, the disruptive blended-learning models are poised to create a significantly less expensive system. They allow the best teachers to extend their reach beyond the confines of traditional classroom cohorts and they offer a viable supervisory role for paraprofessionals who are less trained and less expensive. Meanwhile, as the software improves, it will lead to the compression of the amount of time students spend learning basic core knowledge. This productivity gain will entice students who want to be doing other things than sitting in a traditional seat complying with a standardized calendar.

Together, these value propositions are already starting to draw students from the sustaining plane to the disrupted system. Over time, as the disruptive models of blended learning improve, the new value propositions will be powerful enough to prevail over those of the traditional classroom. The K–12 education system, like countless other sectors, will have experienced the disruption of the classroom.

NOTES

[1] See "The rise of K–12 blended learning," Innosight Institute, January 2011, http://www.innosightinstitute.org/innosight/wp-content/uploads/2011/01/The-Rise-of-K-12-Blended-Learning.pdf; "The rise of K–12 blended learning: Profiles of emerging models," Innosight Institute, May 2011, http://www.innosightinstitute.org/innosight/wp-content/uploads/2011/05/The-Rise-of-K-12-Blended-Learning.pdf; and "Classifying K–12 blended learning," Innosight Institute, May 2012, http://www.innosightinstitute.org/innosight/wp-content/uploads/2012/05/Classifying-K-12-blended-learning2.pdf.

[2] Susan Patrick, David Edwards, Matthew Wicks, and John Watson, "Measuring Quality from Inputs to Outcomes: Creating Student Learning Performance Metrics and Quality Assurance for Online Schools," iNACOL, October 2012, p. 3. In addition, according to some projections, 4 million students were taking online courses outside the jurisdiction of schools in 2011. Sam S. Adkins, "The US PreK–12 Market for Self-paced eLearning Products and Services: 2011-2016 Forecast and Analysis," Ambient Insight, January 2012.

[3] See "The rise of K–12 blended learning," Innosight Institute, January 2011, http://www.innosightinstitute.org/innosight/wp-content/uploads/2011/01/The-Rise-of-K-12-Blended-Learning.pdf; "The rise of K–12 blended learning: Profiles of emerging models," Innosight Institute, May 2011, http://www.innosightinstitute.org/innosight/wp-content/uploads/2011/05/The-Rise-of-K-12-Blended-Learning.pdf; and "Classifying K–12 blended learning," Innosight Institute, May 2012, http://www.innosightinstitute.org/innosight/wp-content/uploads/2012/05/Classifying-K-12-blended-learning2.pdf

[4] For the full explanation of this phenomenon, see Clayton M. Christensen, *The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail* (Boston: Harvard Business School Press, 1997) and Clayton M. Christensen and Michael E. Raynor, T*he Innovator's Solution: Creating and Sustaining Successful Growth* (Boston: Harvard Business Press, 2003), Chapter 2.

[5] As Clayton Christensen has showed, the old technology often uses findings from and developments in the new technology to improve its own performance. The performance of the old technology will often appear to have hit a plateau, but discoveries in the new allow the old to resume its steady, incremental progress. Clayton M. Christensen, "Exploring the Limits of the Technology S-Curve. Part I: Component Technologies," Production and Operations Management, Vol. 1, No. 4, Fall 1992, pp. 334–357. Specifically, for example, in his analysis of the disruption of 14-inch disk drives by 8-inch drives, 8-inch by 5.25-inch designs, and 5.25-inch by 3.5-inch drives, Christensen notes that "When compared to the density of 14-inch drives with equivalent component technology in the total-period sample, the smaller the form factor, the greater the density. This is because smaller drives have more rigid components; the head-disk assembly weighs less, so that it can be positioned more accurately, with less inertia, over more finely-spaced tracks; and there is less vibration. The 8-inch architecture enabled a 10% density improvement over the 14-inch drives; 5.25-inch drives had 20% higher areal density than 14-inch drives with equivalent componentry, and 3.5-inch products enabled an [sic] 37% density increase over 14-inch products, holding component technology and vintage of models constant." But the coefficients of correlation between smaller form factors and greater areal density declined in magnitude and statistical significance over time. "This seems to be the result, according to industry experts, of cross-architecture learning about mechanical and electronic design." Designers of each successively smaller architecture reduced the part count significantly by incorporating more functions that had previously been handled mechanically into the electronics of the drive. Designers of larger-architecture drives were then able to incorporate these design insights into subsequent generations of their 14-, 8-, and 5.25-inch designs." See "Exploring the Limits of the Technology S-Curve. Part I," p. 350.

[6] This section is largely adapted from Chapter 3 of *The Innovator's Dilemma*.

[7] *The Innovator's Dilemma*, p. 64.

[8] This story about steamships is largely adapted from *The Innovator's Dilemma*, pp. 75–76.

[9] The *Savannah* was wrecked off of Long Island in 1821. No other American-owned steamship would cross the Atlantic for nearly 30 years after the Savannah's historic voyage. John H. Morrison, *History of American Steam Navigation* (New York: W. F. Sametz & Co., 1903).

[10] It is worth noting that single-lens reflex (SLR) cameras have incorporated digital in a sustaining hybrid format as well, as the shutters in these cameras still operate by a mechanical mechanism, not an electric one as do "camera phones." Given that the number of people who use SLRs is relatively few, as it serves hobbyists and professional photographers, this may be a place where a hybrid solution prevails for some time to come.

[11] Stephanie Clifford, "Once Proudly Web Only, Shopping Sites Hang Out Real Shingles," *New York Times*, December 18, 2012, http://www.nytimes.com/2012/12/19/business/shopping-sites-open-brick-and-mortar-stores.html. As Maxwell Wessel and Clayton Christensen note, however, in an article in Harvard Business Review, if a disruptor adds too much from the old system into its solution, it can risk losing its disruptive advantage by moving its solution more and more toward the cost structure of the incumbent organizations. Maxwell Wessel and Clayton M. Christensen, "Surviving Disruption," *Harvard Business Review*, December 2012 Reprint R1212C, p. 5.

[12] *The Innovator's Dilemma*, p. 82.

[13] *The Innovator's Dilemma*, pp. 77–78.

[14] Brad Bernatek, Jeffrey Cohen, John Hanlon, and Matthew Wilka, "Blended Learning in Practice: Case Studies from Leading Schools, featuring KIPP Empower Academy," Michael & Susan Dell Foundation, September 2012, http://5a03f68e230384a218e0-938ec019df699e606c950a5614b999bd.r33.cf2.rackcdn.com/Blended_Learning_Kipp_083012.pdf.

[15] Rocketship Education will open in the Fall of 2013 with a new model of blended learning for significant parts of its schools that moves away from the Lab Rotation model. Still, given how Rocketship Education became synonymous in the minds of many with the Lab Rotation model, we felt it was the best example for the purposes of this paper.

[16] Brad Bernatek, Jeffrey Cohen, John Hanlon, and Matthew Wilka, "Blended Learning in Practice: Case Studies from Leading Schools, featuring Rocketship Education," Michael & Susan Dell Foundation, September 2012, http://5a03f68e230384a218e0-938ec019df699e606c950a5614b999bd.r33.cf2.rackcdn.com/msdf-rocketship_04.pdf.

[17] The Flipped-Classroom model appears to be the most problematic category currently in the blended-learning taxonomy, and we invite researchers to improve upon it. The trouble is that the dividing line between the Flipped-Classroom and Flex models is blurry. If the Internet is primarily delivering content and instruction and students are using brick-and-mortar class time for as-needed support according to their individual needs, then the model has Flex characteristics. If, however, students are rotating in cohorts with little differentiated instruction during their brick-and-mortar experiences, then the model resembles what many—including us—refer to as a flipped classroom. Admittedly this distinction is not clear cut because, in theory, students could be engaged in online learning at night from home and then receive flexible, as-needed support during the day at their brick-and-mortar school, and the program would resemble both a Flex and Flipped-Classroom model. We hope to refine the taxonomy over time to make the categories more mutually exclusive.

[18] The exception is the Individual Rotation model, which rotates students on fixed schedules and thus could be more compatible with a seat-time-based system than the Flex, A La Carte, and Enriched Virtual models.

[19] Enriched Virtual models are sustaining innovations relative to full-time virtual schools, but are disruptive innovations relative to the traditional factory-based classroom.

[20] Synchronous teacher lectures that require teachers to lesson plan for an entire class and therefore offer little chance for students to control their path or pace are the mainstay of some online courses. Such courses mirror the traditional face-to-face classroom, except that the teacher communicates on a screen rather than face-to-face. This type of online course does not have the foolproof characteristics of other online courses, which leverage software tools and asynchronous instruction—as well as synchronous teaching sessions—to deliver personalized content. These two types of online courses arguably deserve different categories in the blended-learning taxonomy. The issue presents another possible flaw with the taxonomy that needs further research. For the purposes of this paper, the comments about the foolproof nature of online delivery of content and instruction refer to online material that relies on software tools and asynchronous instruction more than on synchronous teacher lecture.

[21] John E. Chubb, "Overcoming the Governance Challenge in K–12 Online Learning," *Education Reform for the Digital Era, Thomas B. Fordham Institute*, April 2012, pp. 110–111.

[22] This type of a change that occurs within a component of a school—in this case an individual classroom—without affecting other aspects of the school can be implemented by what we call a functional team, in which the team's members do not work with people from other departments.

[23] Because this level of change requires a change in how components within a school fit together, this requires a lightweight team, in which a project manager coordinates members from different departments working together.

[24] *The Innovator's Solution*, Chapter 10. Although the need for a senior administrator to protect the fledgling new model is great, this is not to say that the administrator should over-resource it or expect it to scale too quickly. As *The Innovator's Solution* explains in Chapter 9, the senior leadership behind a disruptive project that has an emergent—as opposed to a deliberate—strategy should be patient for growth but impatient for good results. Allow the project to start small, test assumptions as quickly as possible, and allow the strategy to unfold in a truly emergent way, rather than forcing growth, squandering resources, and insisting on an impossibly deliberate strategy up front.

[25] See Paul T. Hill, "Put Learning First: A Portfolio Approach to Public Schools," Progressive Policy Institute Report, February 2006, http://www.eric.ed.gov/PDFS/ED491223.pdf. A portfolio approach opens the way for different school types for different students. At the operations level, this means allowing schools to control their own budgets, hiring, and curriculum planning. Districts take on the role of authorizers. As such, districts should open umbrella charters to those organizations with a successful track record so that innovative charter management organizations looking to expand, like Rocketship Education, will find these locales attractive places to put down roots. Under the portfolio model, the critical function of the district shifts from mandating a uniform and standardized methodology for serving all students, to defining a clear expectation of outcomes and then authorizing a diversity of providers to hit those targets, each in its own way. The Center for Reinventing Public Education (CRPE) has identified seven components of a portfolio strategy. Specific implementation steps are available at www.crpe.org/portfolio.

About the Institute

The Clayton Christensen Institute for Disruptive Innovation is a nonprofit, nonpartisan think tank dedicated to improving the world through disruptive innovation. Founded on the theories of Harvard professor Clayton M. Christensen, the Institute offers a unique framework for understanding many of society's most pressing problems. Its mission is ambitious but clear: work to shape and elevate the conversation surrounding these issues through rigorous research and public outreach. With an initial focus on education and health care, the Christensen Institute is redefining the way policymakers, community leaders, and innovators address the problems of our day by distilling and promoting the transformational power of disruptive innovation.

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