Clayton Christensen Institute for Disruptive Innovation

A blueprint for breakthroughs: Federally funded education research in 2016 and beyond

By Michael B. Horn and Julia Freeland Fisher

EXECUTIVE SUMMARY

The federal government funds a significant proportion of education research in the United States. But these research efforts have, by and large, fallen short of delivering on the promise to drive individual student outcomes across the country. By altering the priorities of education research to embrace a more complete research cycle, the federal government can boost the productivity of future efforts.

Why is education research critical to student success?

- **Systemic upgrading.** The vast majority of U.S. schools operate in a century-old, factory-based education model that standardizes the way students are taught. Meaningful research is vital in enabling schools to transition to newer, more effective learning models that customize to students' distinct needs.

- **Technological advantages.** With the rise of technology, education is undergoing a sea change. Proper research will help guide the implementation of new tools and resources that will help educators optimize the learning experience for each student.

- **Empowered educators.** Educators face complex circumstances, like what to do when a child is struggling or how best to engage and motivate students. Research is critical in arming educators with useful information about how best to serve each student.

- **Increased proficiency rates for all students.** Today's standardized factory model of education yields highly variable student outcomes. The past decades have been fraught with only gradual progress toward closing persistent achievement gaps. Better research can help the system improve more quickly and predictably against these goals.

What is the current state of education research?

- **Funding is limited and fragmented.** The federal government primarily funds education research through three agencies: the Institute of Education Sciences, the National Science Foundation, and the National Institutes of Health. Education research funding levels remain far below those of other industries such as defense, energy, and health care.

- **Randomized controlled trials are the gold standard.** Randomized controlled trials, or RCTs, involve comparing students who experienced a given approach with those who did not in an effort to surface effective practices. President George W. Bush's administration created the What Works Clearinghouse, which promulgated these trials as a key method to unearth successful teaching practices.

- **RCTs unearth what is most likely to work, but do not offer precise guidance.** RCTs are often expensive and time-consuming, and they typically only shed light on what is most likely to work *on average*, whereas educators need a level of information to chart predictably effective paths for *each student*. For example, a recent federally funded RCT analyzing the efficacy of an adaptive math software found that the software led to an *average* eight-percentile point gain among students. Although a thorough, well-funded study like this signals promise, findings like these do not reliably tell us *why* some portion of students or certain classes likely didn't fare as well whereas others fared far better.

- **The research cycle is incomplete.** If we want to understand what works predictably for different students in different circumstances, then the current research process is incomplete. Although RCTs help identify useful practices and are an important step in the research process, when treated as an end they rarely provide information that is actionable for decision-makers in the education system. We need to develop theories that explain why given experiences or interventions do or do not work for given students in different circumstances.

A research agenda for student-centered learning

An effective research agenda moves beyond merely identifying correlations of what works *on average* to articulate and test theories about *how* and *why* certain educational interventions work in different circumstances for different students. To do this, the government will need to:

1. Focus on the individual, not the average

- Encourage research that pushes our understanding beyond the average student and instead works to discover predictably effective paths for each student.

- Take advantage of technology-enabled structural shifts to study what works for specific students in specific circumstances.

- Fund efforts that make data collection more seamless and less arduous on districts in order to allow schools and researchers to collect better, more real-time data on what is actually happening in schools.

- Support research that progresses past initial RCTs and promotes alternative methods for unearthing what drives student outcomes in different circumstances.

2. Push toward causal understanding

- Focus on the development of theories that explain why certain approaches do or do not work in certain circumstances. For example, do certain interventions work best for certain student populations at a certain point in their learning trajectory? Do particular software tools work better for practicing hard skills, whereas others excel at training students to persist through challenges?

- Encourage research that digs in on anomalies—instances where the prevailing research cannot explain a certain result—to surface new explanations and refine our understanding of what drives individual learning.

- Serve as a hub for collecting and studying these anomalies.

3. Continue to fund research, not development

- Focus on the research in research and development (R&D) in order to shed light on what works for what students in what circumstances—and allow the education industry to develop tools in accordance with those findings.

- Beware of conflating needs for actual market demand. Policymakers and funders often perceive needs in the system that do not translate into areas where schools will spend money. As a result, the government could fund the development of tools that might not see the light of day in actual classrooms.

4. Coordinate the research cycle toward completion

- Maximize the use of scarce research funds by creating criteria for the types of questions facing education that will further the efforts to personalize learning. To do this, fund core questions that support educators on the ground by shedding light on what works, for which students, in what circumstances.

- Deploy research spending to usher in a new, more complete cycle of research; although RCTs are important, they are neither the king nor the final step of the research process.

WHAT'S WRONG WITH THE NATION'S APPROACH TO EDUCATION RESEARCH?

As the 2016 presidential election approaches, the next U.S. president will have the opportunity to bolster the federal research agenda in education. Historically, research in education has fallen short both in terms of funding and strategy. But a coherent research agenda will be vital to bringing America's schools into the 21st century.

Over the past decade, President George W. Bush and President Barack Obama have each proposed agendas to expand our fundamental understanding of what works in education and to scale the development of tools to help drive learning. Under the Bush administration, the creation of the What Works Clearinghouse, the U.S. Department of Education's database of high-quality research, formally ushered in the randomized controlled trial, or RCT, as the "gold standard" of education research. An RCT is a study design that randomly assigns participants to an experimental group or a control group, which, in turn, isolates the effects of the tested intervention. By creating a higher bar for determining what research would gain the U.S. Department of Education's stamp of approval, the What Works Clearinghouse continues to attempt to support and highlight research that can answer the question "does this intervention work?" with confidence.[1]

The Obama administration focused on increasing the development and use of research and evidence in program selection and resource allocation. This effort included defining shared standards of evidence between the Institute of Education Sciences and the National Science Foundation on a spectrum ranging from simple data gathering on early stage developments to gold standard evaluations; using the Investing in Innovation Fund (i3) and other programs to establish a framework for how educational programs should receive funding based on the type and level of evidence supporting their efficacy; creating research partnerships between school systems and networks of researchers; training researchers and technical assistance providers to develop and manage rigorous evaluations; and coding and making open the metadata from tens of thousands of evaluations. Additionally, given the U.S. Department of Education's limited resources, the Administration launched an interagency subcommittee on learning science and technology as part of the National Science and Technology Council. This subcommittee spawned several complementary efforts—including the BRAIN Initiative.[2] The Administration also unsuccessfully attempted to move beyond just funding research by creating an Advanced Research Projects Agency (ARPA) for education to pursue an advanced research and development agenda modeled after the Defense Advanced Research Projects Agency (DARPA)—the prolific development arm of the U.S. Department of Defense—that would fund directed development projects in education.[3]

Both administrations' efforts took steps toward bolstering the level of rigor in education research and improving the research process. Neither, however, went far enough toward giving educators on the ground actionable insights that would allow them to serve effectively each and every student in their schools.

This limitation has become more glaring than ever before, as the rapid rise of technology is changing education as we know it. We predict that by 2019, half of all high school courses will be online in some form or fashion. And across K–12 education, we have observed and documented the proliferation of blended-learning models that weave together online learning and traditional schools.[4]

For the first time in our country's history, technology affords schools a structure capable of reaching each student at scale.

At its best, integrating technology into our schools and classrooms stands to mark a radical departure from our traditional, factory-based school system that continues to fall short of our aspirations of reaching *all* students. Armed with technology, no longer must we resort to "teaching to the middle" or allowing students to progress to new material and higher grade levels before they've mastered the fundamentals. With technology as a tool, schools can move from a one-size-fits-none approach to a student-centered one. Teachers can gain a far more precise understanding of how *individual* students are progressing and provide them with just-in-time materials and supports suited to their needs and strengths. In some schools that are taking advantage of the power of online learning, students can chart distinct paths that allow them to access, at their own pace, a variety of online and offline learning modules, supports, and experiences that are tailored to their learning needs. ***Figure 1*** illustrates this sea change from a factory-based to a student-centered model.

In other words, for the first time in our country's history, technology affords schools a structure capable of reaching each student at scale. This raises fundamentally different questions that we need education research to tackle. In this new context, neither President Bush's focus on what interventions are most likely to work, according to RCT studies, nor President Obama's focus on STEM education, innovative development projects, or tiered-evidence standards that do not progress beyond an initial RCT will suffice.

Instead, the ability to predict *what works, for which students, in what circumstances*, will be crucial for building effective, personalized-learning environments. The current education research paradigm, however, stops short of offering this predictive power and gets stuck measuring average student and sub-group outcomes and drawing conclusions based on correlations, with little insight into the discrete, particular contexts and causal factors that yield student success or failure. Those observations that do move toward a causal understanding often stop short of helping understand why a given intervention or methodology works in certain circumstances, but not in others.

The ability to predict *what works, for which students, in what circumstances,* will be crucial for building effective, personalized-learning environments.

These insights, in turn, fail to drive the effective development of tools that would actually transform student outcomes. Technology, in other words, will only be as good as our understanding of what drives learning in which circumstances. Technology, of course, can be a tool to develop that understanding through sophisticated data analytics and faster research cycles; this will only be the case, however, if we use technology in the right ways to answer new questions about how students learn.

To usher the nation's schools into the 21st century, the next president should conquer the chronic shortcomings of education research and call for a new way of investigating what drives learning. What follows summarizes what a new research methodology ought to look like and how the next president can put these ideas into action.

Transforming K-12 Education

Traditional Education

- Industrial Age
- Mass Production
- Time Constant & Achievement Variable
- Advance Based on Seat Time
- Geographically Limited

Student-Centered Learning

- ✔ Knowledge Age
- ✔ Customization
- ✔ Time Variable & Achievement Constant
- ✔ Advance Based on Competency
- ✔ Geographically Flexible

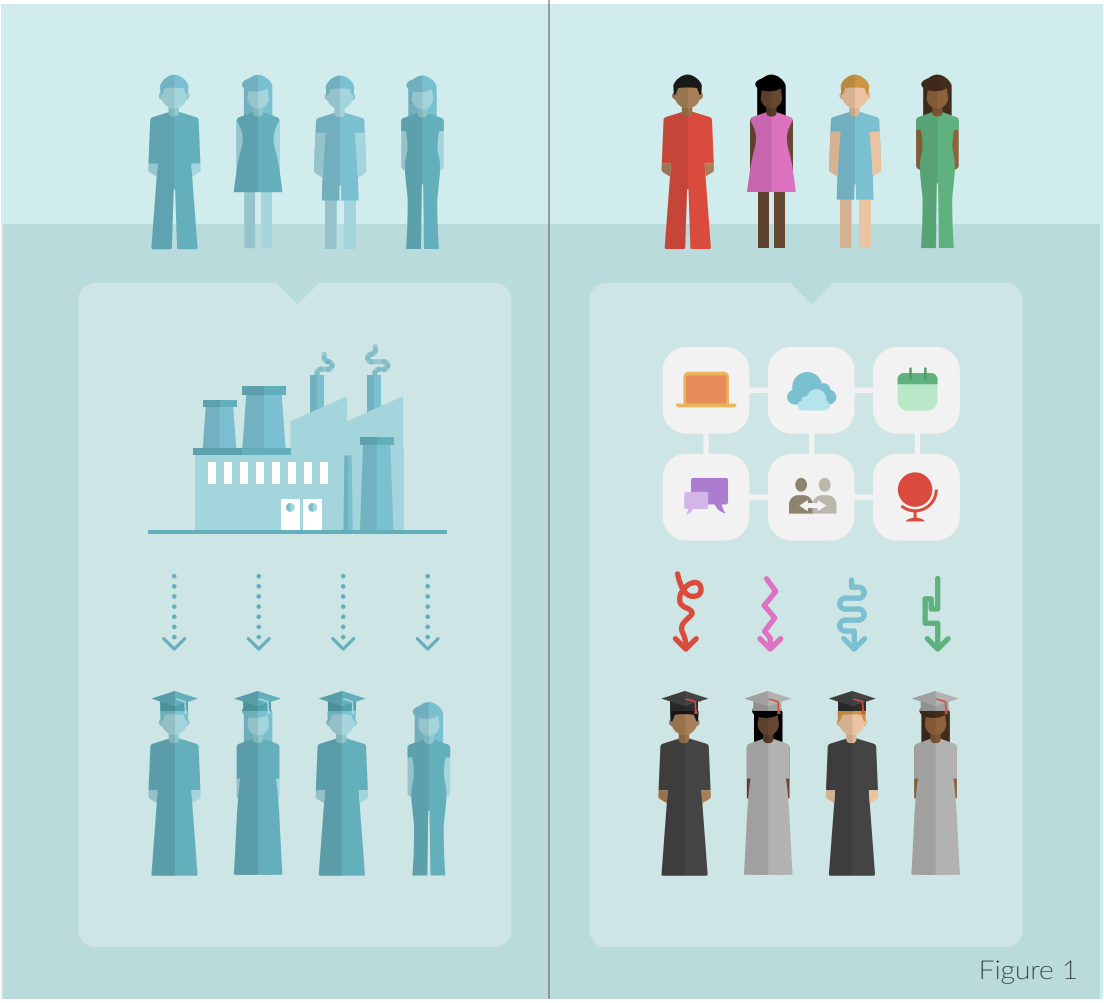

Figure 1

EDUCATION IS STUCK IN AN INCOMPLETE RESEARCH CYCLE

There is a lot of education research. Some is filled with mountains of statistical evidence, other consists of the results from an RCT, and still other examines various case studies. But the prevailing paradigm in which education researchers have been trapped does not give them a chance to produce research that can predictably lead to better schools. Instead, the existing paradigm causes researchers to stop their work when it still does not provide complete answers to practitioners. This research gives us detailed statements of correlation, which sometimes control for a wide range of variables. But it does not provide us with sound theories of causation that researchers can continue to test and refine. Most—although certainly not all—education research consequently creates more contention than consensus. Even the What Works Clearinghouse, which sets parameters for evidence standards to improve the effectiveness of various education interventions, provides insights that are at best incomplete. Although this effort sets higher standards for the sorts of evidence that constitute "proof" of a particular intervention's effectiveness, the findings featured in the What Works Clearinghouse fail to communicate whether given interventions will work for teachers and administrators working with individual students in different circumstances across the numerous local contexts that make up our public education system.

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The ability to know what actions will lead to desired results for a specific student, in a specific school, in a specific situation, awaits the development of a more iterative research process.

Moving to predictive, circumstance-based theories of causation in education will require a shift beyond the prevailing paradigm. No longer will research on "best practices" or "what works" best *on average*—or what is most likely to work for any student—across education suffice. RCTs can be useful preliminary steps on the road to robust bodies of understanding, but when education research reaches this stage, it all too often fails to progress beyond it. This stage causes paralysis when educators cannot determine from such studies whether following an average formula will lead to hoped-for outcomes for specific students. Moreover, empirical knowledge may be good at explaining the past, but only a causal understanding can help us peer into the future.

The ability to know what actions will lead to desired results for a specific student, in a specific school, in a specific situation, awaits the development of a more iterative research process.[5] ***Figure 2*** illustrates this more complete research cycle.

Life of the Research Cycle

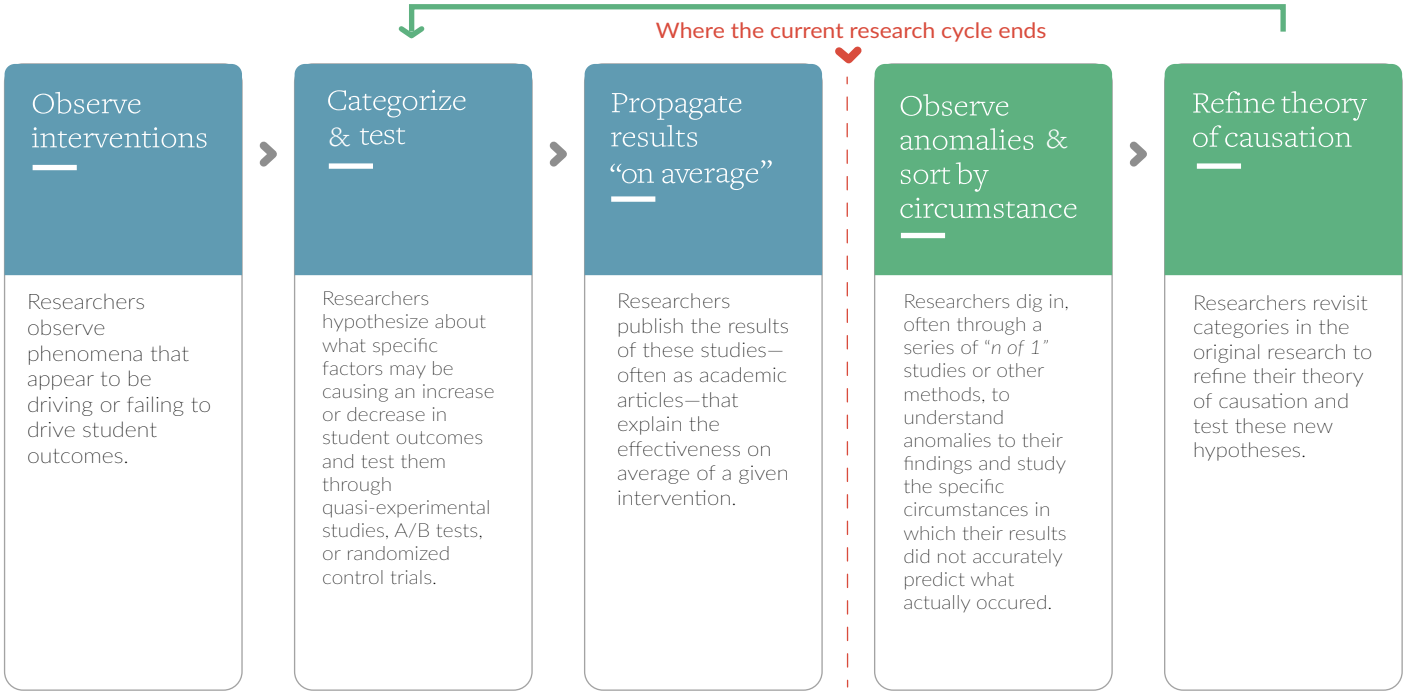

Figure 2

In traditional education research, researchers begin by observing phenomena, such as identifying situations in which students are succeeding or failing to varying degrees. They then move on to define and test the categories that they think contribute to those outcomes, often through quantitative research that tests the effectiveness of various interventions. This phase of the research is focused primarily on describing interventions and correlating results and sometimes involves randomly allocating treatments and comparing treatment and control groups. The RCT can be a vital tool at this stage of research. In addition to random assignment, in many cases, researchers can use sophisticated modeling to test mediating and moderating variables along with overall significance in outcomes. And increasingly, these studies also include latent class analysis and within-group measures to study effect sizes specific to certain student populations or contexts. Such studies help us gain a better understanding of how much a particular treatment did or did not influence the outcome of interest, thereby moving researchers toward an initial understanding of causality.

Alternatively, as a cheaper and quicker approach, researchers or practitioners can use A/B testing—common today in marketing—to test their hypotheses in lower stakes environments. Many times shorter cycle A/B tests can start to reveal what is or isn't working in a specific classroom to help researchers and educators alike.

The research process typically ends there, however. This is unfortunate because even the most sophisticated statistical modeling will rarely lead to a foolproof understanding of causation. In other words, this sort of modeling is built to weed out anomalies—outcomes that the findings of the study cannot explain—as statistical noise, whereas understanding these occurrences is critical to discovering causality that leads to actionable insights based on different circumstances. As a result, the findings from these elaborate studies tend to focus on the average effects at the group or sub-group level of the originally conceived categories, which leave us with little actionable insight into the underlying cause of student achievement or lack thereof for many students.[6]

A number of key steps must follow to improve upon these preliminary empirical research tests and to help us reach an understanding of the causal factors in different circumstances that drive learning and provide prescriptive—rather than merely descriptive—guidance for educators. This must involve progressing to assert a statement of what causes the outcome of interest—a theory, in other words. Researchers must then put on their statement of causality like a set of lenses and cycle deductively back to observe, categorize, and test their theory across a variety of contexts. They say, "When we observe these actions being taken, these should be the outcomes we observe."

New insights and anomalies are good news because they allow researchers to say, "There's something else going on here," and that is what leads to better understanding.

During this phase, researchers must continue to refine statements of causation on the basis of new forms of inquiry. First, they can conduct more narrow *"n of 1"* studies of particular individuals within the original study to capture nuances that statistical analyses may have missed. Second, they can seek exceptions, called *anomalies*, to the average tendencies identified in their initial empirical work. It is only when we find something that the preliminary empirical research's correlation cannot explain that the research can improve. Such new insights and anomalies are good news because they allow researchers to say, "There's something else going on here," and that is what leads to better understanding. They then must delve back into the initial steps of the research cycle and account for the anomalies by revisiting the categorization stage and continuing to test their theory from there. This work occurs rarely in education research—or if it does, it does so in a way that does not improve existing theories or evidence, but is instead framed as directly contradictory to prevailing findings.

There is another significant difference here that departs from the traditional research paradigm in education. Rather than categorizing by different *attributes* of the phenomena or different demographics of human subjects, researchers building toward an understanding of causation start to categorize the different *circumstances* in which administrators, students, or teachers might find themselves. They do this by asking, when they encounter an anomaly, "What was it about the situation in which those people found themselves that caused the causal mechanism to yield a different result?" If they find themselves in a circumstance where they must change actions or organizations to achieve the desired outcome, then they have crossed a salient boundary into another category. As they cycle through this research process, anomaly-seeking researchers will ultimately define each of the different circumstances in which administrators, teachers, or students might find themselves when pursuing the outcomes of interest.

Unfortunately, research into programs designed to personalize learning rarely go far enough to unearth such causal mechanisms or circumstance-based insights. In addition to random assignments to condition, research of this sort will also require better set-ups, better data about participants, and better analytics to tease out what works for whom, as opposed to simplistic reporting only on effect sizes for whole populations. Without the complete research cycle outlined above, we stand to limit what practitioners looking to personalize learning to their students' needs and circumstances can actually *do* with the research findings.

For example, a recent U.S. Department of Education-funded RAND RCT study of Carnegie Learning's Cognitive Tutor Algebra I (CTAI) product found that CTAI boosted the average student's performance by approximately eight percentile points. Researchers emphasized that this study considered "authentic implementation" settings—that is, they tested the relative effectiveness of the program in actual school settings across a diverse array of students and teachers. Carefully studying authentic implementation sounds promising, but only if the researchers can spend sufficient time observing and revisiting the authentic circumstances surrounding the implementation, which may be affecting student results. Instead, however, when a thorough, well-funded study like this demonstrates that a high enough proportion of students benefit from an intervention, we tend to double down on those promising signals. In turn, the fact that some portion of students or certain classes likely didn't fare as well—and others fared far better—is treated as probabilistic noise from which statistically significant signals of efficacy must be isolated. But generalizing research findings like this will not be helpful if we are trying to build systems that predictably support students based on their specific needs.

To establish a sound theory of precisely why and how a product, such as CTAI or any particular model, can drive outcomes, additional stages of research must embrace the descriptive and prescriptive processes outlined above. To push these findings further, researchers should dig in on the anomalies hidden within averages—students or schools for whom the intervention was not successful or was wildly successful—to tease apart what was different about the circumstances where those anomalies arose. With this information, schools and teachers could better understand which students, in which circumstances, would benefit from the product or intervention and to what extent—and the company itself could improve its offering with additional approaches or a sounder understanding of when to use which approach for a wider array of circumstances. With enough information of this sort, school systems would have the right information to deploy the right tools that could predictably serve certain students.

Particular products are not the only research subjects vulnerable to getting stuck in merely descriptive conclusions. Even well-known research that withstands the test of time, such as Benjamin Bloom's "2 Sigma problem" research, falls into a similar trap. There is now widespread agreement on the potent effect that Bloom found that one-on-one tutoring could have on student learning, including through RCTs; and Bloom's subsequent studies of "objects of change" leant additional insights into the discrete activities and categories within tutoring that showed strong effects. Yet, there is still limited understanding of which aspects of one-on-one tutoring actually cause different students to reap the benefits of that experience. Not surprisingly, then, even as adaptive courseware companies seek to replicate the virtues of the one-on-one tutoring that Bloom wrote about, none have been able to achieve foolproof outcomes for all students.

THE MYTH OF A CLEAR-CUT CUSTOMER IN EDUCATION

In addition to the incompleteness in the current research paradigm, the education market presents challenges when it comes to developing products based on the research to solve endemic problems in schools. Schools will, of course, need new tools to differentiate learning with far greater precision than they can today, but government-led efforts to move beyond just funding research and into supporting development at this stage—like the failed effort to create an ARPA-ED modeled after the military's prestigious DARPA[7]—pose two risks.

First, the old adage "if you build it, they will come" does not pan out in the education market. Demand in education is highly fragmented, and factors—such as lengthy procurement cycles, political pressures in different localities, an emphasis on things beyond strict academic results, and tight budgets, to name a few—mean that schools' "needs" do not translate predictably into "demand" in the education marketplace. Even gold standard products have struggled to see their solutions translate into sales. The elusive customer base in education makes government-coordinated development projects a tricky proposition.[8] Second, because districts receive funds from so many disparate sources at the state, local, and federal levels with various strings attached and because all of these sources have different local political considerations at hand, in practice it is quite difficult to predict demand. This makes public school districts—the customers for the vast majority of educational products and services in this country—markedly different from the military, which is also government funded but only at the federal level. It therefore suggests that an ARPA-ED might not enjoy the success that DARPA has. Similarly, the reason that companies don't invest lots of dollars in basic R&D in education isn't because they don't want to fund risky projects per se—one rationale for creating ARPA-ED—it's more because the market won't support that activity.

Because of these market factors, federal attempts to contribute directly to the supply side of the education market may not hold as much promise as we might hope. For example, the Office of Science and Technology Policy is currently spearheading an effort to generate high-impact learning technologies through the use of "pull mechanisms"—grants structured to incentivize private sector engagement and competition by creating viable market demand for specific products. The traditional design of the XPRIZE is a good example of a pull mechanism, as are government challenge grants and social impact bonds. Although this design solves the customer and demand problem in the short term, there's no saying that the products or services that result from the policy will be viable in the long run.

The federal government should resist taking aim at supposedly market-oriented development projects—the kind that companies won't fund because there is no market. The federal government is immune to market pressures, but it's also notoriously bad at predicting school district demand itself. This means that the federal government may fund the creation of some exciting things, which may very well not get adopted widely and therefore will transform little about the education system.

A NEW VISION OF RESEARCH: BETTER INFORMATION TO DRIVE PERSONALIZED LEARNING

With these factors in mind, the government should double down on funding more basic and applied research through the entirety of the research cycle described in ***Figure 2***. This would provide much-needed information and insights to practitioners at all levels of the education system, particularly to those pursuing personalized learning models.[9]

The U.S. Department of Education could help to ensure that researchers are posing key questions that will further personalized learning. It could also serve as a hub for collecting and studying anomalies to previous studies' findings that need continued refinement.[10] Finally, it could establish more opportunities for circumstance- and theory-based research by funding the creation of infrastructure systems that alleviate the friction and costs of schools and researchers to collect more and better information on what is actually happening in schools.

A richer base of theories of causation in education research could also dramatically enhance development efforts at less cost to the government by relying on the current surge in private investment in education technology. Currently, education companies are conducting development projects in-house, but by and large seem to be doing so on the basis of intuition or paltry research that lacks predictive power. As a result, their efforts may have only modest effects on student learning. A more robust effort to fund and coordinate more complete research cycles, however, would, in turn, arm companies with the right information around which to design new products and services that could be effectively personalized to meet students' needs.

That is not to say that the government should never play a role in directed development that fills gaps in the supply of education tools. More robust information may also get closer to resolving some of the fragmentation in school system demand, as school systems gain reliable insight into what works for what students and deploy resources accordingly. Once schools have more precise information about the products at their disposal, then patterns of school district and state demand may become more predictable and focused around adopting products and services that work in discrete circumstances. Only then will federally supported development projects be a potent instrument to yield breakthrough developments in personalized learning tools if the private sector does not step up.

This proposal represents a significant upfront investment in education research, which we have not seen in recent decades[11] and remains an acute challenge. Taking the long view, however, suggests that insights into causal mechanisms of what drives learning in what circumstances ultimately stands to mitigate the otherwise guaranteed waste involved in interventions that prove out on average, but with which we inevitably apply too broad a brush. Once we can accurately predict whether something will succeed or fail and in what circumstances, education dollars will stand to go markedly further in meeting the needs and capitalizing on the strengths of each student.

Notes

1. "The Education Sciences Reform Act of 2002," H.R. 3801, 107th Cong., 2002, http://ies.ed.gov/pdf/PL107-279.pdf. "Biennial Report to Congress," Institute of Education Sciences, 2005, http://ies.ed.gov/pdf/biennialrpt05.pdf. "Connecting Research and Practice to Improve Education," What Works Clearinghouse, Institute of Education Sciences, http://ies.ed.gov/ncee/wwc/pdf/reference_resources/wwc_ebrochure_062714.pdf.

2. Thank you to Jim Shelton, former deputy secretary of education, for helping us synthesize the Obama administration's many efforts to advance the state of education research.

3. Sarah D. Sparks, "Obama Unveils Education Research Initiative Modeled on DARPA," *Education Week*, February 14, 2011, http://www.edweek.org/ew/articles/2011/02/14/21arpa-ed.h30.html (accessed September 9, 2015).

4. For more, see "Blended Learning Universe," Clayton Christensen Institute, http://www.blendedlearning.org.

5. Some in the medical industry have used the term "enriched research trial" to describe a more complete research cycle. For example, see Robert Temple, "Enrichment Design Studies Should Enhance Signals of Effectiveness," U.S. Food and Drug Administration, December 12, 2014, http://www.fda.gov/Drugs/NewsEvents/ucm295054.htm (accessed September 9, 2015).

6. In recent years, a call for more, quicker cycle RCTs has grown in the education reform community. Virtual environments may be especially fertile ground for faster cycle experiments of this type. We believe, however, that simply doing more RCTs more quickly may not get us closer to causal statements regarding what works in which circumstances. This requires the additional steps, outlined in this paper, of generating a theory of causation and testing this theory across a variety of circumstances to refine that theory over time.

7. DARPA essentially works by funding projects that have a three- to five-year time horizon and address specific technology challenges that are important to the U.S. Department of Defense—its customer. One of the key reasons DARPA works well is because it clearly understands its customer's needs; the U.S. Department of Defense is a consumer of these research projects. As we understand it, if DARPA funds something that solves a challenge, the military is nearly certain to adopt it, so the market functions well. To put it in economic terms, there is a demand from the military (which is funded by the federal government), and the federal government funds the supply side as well. The two match up.

8. In her book, Marguerite Roza shows how districts don't even realize that their strategy, in practice, is very different from what their intended one is, as their actual spending and resource allocation processes do not align at all to their stated goals. It's not that the market is fragmented per se, but that districts act in seemingly quirky ways and often define the requirements of their jobs to be done differently from each other; there are long buying cycles in education; and districts often break contracts when changes occur in their leadership. All of these processes make it difficult for innovative products and services to penetrate the market. See Marguerite Roza, *Educational Economics: Where Do School Funds Go?* (Washington, D.C.: The Urban Institute Press, 2010).

9. Today, for example, the education software market itself is sorted by features and functions (what education technology companies say their tools can do), rather than by actual use cases (to what end schools are actually using those tools in particular classrooms, relative to particular students, with particular needs). The more complete our research cycles become, the more valuable information will be available to practitioners trying to choose from the vast array of technologies that can best support their students.

10. For example, the U.S. Department of Education could coordinate an RFP process looking for anomalies to the 2 Sigma study, around which many learning technologies loosely base their individualized learning products. It is worth noting that this type of process would obviously require some degree of data transparency tied to the original research upon which the anomalies are built.

11. The total amount of federal dollars allocated specifically to education R&D for fiscal years 2010–15 was $1.14 billion, or 2.85 percent of the total U.S. Department of Education budget during that same time period. This number was determined by looking at the amount of funds allocated specifically for the R&D function within the Institute of Education Sciences—the statistics, research, and evaluation arm of the U.S. Department of Education—as part of the total U.S. Department of Education budget. These numbers, shown in the table below, were taken from the federal education budgets for fiscal years 2010–15, see "Budget News—U.S. Department of Education," U.S. Department of Education, http://www2.ed.gov/about/overview/budget/news.html and "Department of Education: Archives of Budget News," U.S. Department of Education, http://www2.ed.gov/offices/OUS/Archives/archive.html (accessed September 9, 2015).

Federal Education Budget, FY 2010–15

Fiscal year (FY)	U.S. Department of Education budget	Institute of Education Sciences budget	R&D portion of Institute of Education Sciences budget	Percentage of U.S. Department of Education budget allocated specifically to R&D*
2010	$59.2 B	$659 M	$200.2 M	3.38%
2011	$69.9 B	$659 M	$200.2 M	2.86%
2012	$68.1 B	$593.7 M	$189.8 M	2.78%
2013	$68.4 B	$593.7 M	$189.8 M	2.78%
2014	$67.3 B	$577 M	$179.9 M	2.67%
2015	$67.1 B	$574 M	$179.9 M	2.68%
AVERAGE (2010 - 15)	**$66.6 B**	**$609.4 M**	**$190 M**	**2.85%**

*These percentages were found by dividing the R&D portion of the Institute of Education Sciences budget by the total U.S. Department of Education budget.

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 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.

About the Authors

Michael B. Horn is the co-founder of and a distinguished fellow at the Clayton Christensen Institute and a principal consultant for Entangled Solutions, which offers innovation services to higher education institutions. Michael is the co-author of *Disrupting Class: How Disruptive Innovation Will Change the Way the World Learns* and *Blended: Using Disruptive Innovation to Improve Schools*.

Julia Freeland Fisher is the director of education research at the Clayton Christensen Institute, where she leads a team that educates policymakers and community leaders on the power of disruptive innovation in the K–12 and higher education spheres through its research. Her current research focuses on innovative policies and practices in K–12 education.