

SPOTLIGHT

Technology's Promise

by John J-H Kim and Kyla Wilkes

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ver the past decade, U.S. K-12 schools have invested an estimated \$100 billion in classroom technology, yet there has been little evidence of significant impact.¹ Test scores remain stagnant and achievement gaps continue to grow. And while some schools now have desktop, laptop, or tablet devices, a deeper observation of most classrooms would reveal that the methods of instruction have remain largely unchanged. This stands in stark contrast with the dramatic transformations we have seen in American industry and even in our daily lives over the past ten years. We now listen to music that is curated and personalized to match our preferences, we have access to data that will tell us how many steps we take and how many calories we burn, we can communicate with fellow drivers about traffic conditions in real time, and we have the convenience of ordering everything from food to designer shoes to insurance, all with the click of a button.

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Technology's dramatic impact on American industry and on our day-to-day lives begs the question: will the promise of technology finally be realized in schools? And if so, when will that happen? What can be done to ensure that technology meaningfully enhances the learning experience and outcomes for students? Despite the disappointments over the past couple of decades, we may now be at an inflection point. Due to a confluence of factors, we are beginning to see the possibility of meaningful change. Here we will explore the various forces that are converging, discuss the types of issues in education that technology is seeking to address, and provide some lessons learned and recommendations for moving forward.

Whiletechnology is not and will not be a panacea for the many complex challenges confronting the U.S. K-12 education system, people are increasingly embracing the notion that, when done well, technological innovations can be an important piece of the solution. If harnessed correctly, technology has the power to reignite students' passion for learning, allow teachers to individualize instruction and improve results, and provide school administrators with creative and effective ways for improving district budgets.

Why Now?

With so little to show for the past decade of investments in technology in U.S. public schools, why might it be different going forward? In examining the current landscape, we see multiple forces converging to create significant momentum. More powerful technology at lower cost, shifts in education policy, the big data movement, and increased capital investments are coming together to create a burst of new product offerings and new ideas about methods of instruction, thus creating the conditions for potentially transformative change in classrooms around the country.

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> In large part, technology's ubiquity is fueling the growing buzz and pressure to adopt technology in the classroom. Technological improvements and declining costs have led to widespread adoption of mobile devices that have more computing power than the large mainframe computers of the mid-20th century. Additionally, a plethora of lowcost digital applications and content are now available, offering access to information at any time and from almost anywhere. This digital pervasiveness has driven significant changes in sociocultural norms such as expectations of rapid responsiveness, free information, and digital social engagement. These new norms are disrupting our previous beliefs about how and when learning should happen.

> Broad policy shifts and movements in education have also helped to stimulate innovation in the education sector:

- In 2001, the No Child Left Behind Act (NCLB) contributed to a paradigm shift in public education—the act placed an increased emphasis on accountability and data, and created a new, reform-centered narrative. In response, many districts began to innovate and experiment with new ways to raise achievement and close student proficiency gaps.
- The 21st-century skills movement has sparked a national conversation between the business community, education leaders, and policymakers about ensuring that all students develop the skills considered critical to success in today's

rapidly changing work world. Advocates of the movement argue that our current model of education was designed to meet the needs of very different economic times-large, standardized classrooms were inspired by the industrial age, and were designed to cultivate identical individuals who could be employed in bureaucratic or factory-based careers.² Because our economy has changed dramatically, the types of skills that students need to succeed in the information age include information, media, and technology skills along with a host of other skills, such as critical thinking, collaborating, communication, and leadership. According to a multi-year study started by the Conference Board in 2006, over 40% of employer respondents rated new entrants with a high school diploma as "Deficient" in their "Overall Preparation" for the entry-level jobs they typically fill.³ These employers are placing substantial pressure on schools to help better foster 21st-century skills, and education leaders have begun to reflect on how they can use technology to respond to this challenge.

• The Common Core Standards Initiative, an effort launched in 2009 by state leaders including governors and state commissioners of education, is creating more consistent education standards across the United States, which may provide more opportunity for technology to take hold.⁴ Prior to the Common Core, each state independently determined its curriculum standards. As a result, standards varied significantly, with students in Oklahoma receiving a very different education than students in Massachusetts, for example. Because of this variation in standards, education technology companies were unable to build a product that worked for multiple districts; they spent significant time and resources customizing solutions for multiple users, which resulted in a lengthy and arduous product development and sales cycle. With the advent of the Common Core, education technology companies can be more confident that the products they build will apply to instruction in both a small rural South Dakota district and an urban New England district.

The increased computing power discussed above has led to a dramatic rise in the availability of data. "Big data" has affected everything from the way we shop to the way we catch



criminals. Schools are collecting more data than ever before, and many districts have hired chief information and data officers to ensure that schools make this abundance of data actionable. In much the same way that Amazon uses data to tailor one's shopping experience based on needs, desires, and preferred modalities, many believe that education can use data to customize the learning experience for students. This belief has led many districts to invest in more sophisticated databases and data dashboards to help school leaders and teachers make use of this wave of big data.

And finally, the force of the drivers detailed above has been amplified by increased capital-both public and privateflowing into the education technology sector. In June 2013, President Obama launched the ConnectED initiative, committing to the goal that 99% of American students will have access to next-generation broadband by 2017; more recently, he announced \$750 million in pledges from the private sector for student technology and a doubling of funding from the Federal Communications Commission to provide high-speed wireless Internet to schools and libraries. In addition to public funds, private equity and venture capital firms have an increased interest in this area, leading to unprecedented levels of activity. Investments in the education technology industry hit \$1.1 billion in 2012, a 51% compounded annual growth rate (CAGR) from 2006 (this represents all education technology investment activity, not just K-12).⁵ And more recently, the first quarter of 2014 alone witnessed \$559 million invested across 103 deals.⁶ Top-tier venture capital firms, such as Andreessen Horowitz, Bessemer Venture Partners, and Highland Capital Partners, have also become active early-stage investors in this sector.⁷ New breeds of philanthropic ventures such as New Schools Venture Fund are providing seed funding to startup organizations developing new technology products. Large education, media, and technology companies have made significant acquisitions and investments to enhance their product offerings and take advantage of potential new market opportunities. And let's not forget about the schools themselves: this year alone, K-12 schools are projected to spend almost \$10 billion on education technology, a nearly \$200 million increase from 2013, according to the Center for Digital Education.⁸

What Types of Solutions Are Ed Tech Products Offering?

What types of products are proliferating in this education technology boom? An analysis of the available products and services reveals that most education technology companies are trying to address some combination of the following three issues: personalization, productivity, and access.



Personalization

Individuals learn at different paces and through different methods, and have varied interests and preferences. Although this fact is known and essentially undisputed, most schools are structured to provide all students with very similar learning experiences. A number of companies have responded to this problem by developing tools with adaptive technologytechnology that can modify the timing of content and modality according to student learning need (as indicated by students' responses to prior online assessments and activities). For example, software may be able to detect via regular digital assessments that Lewis struggles specifically with multiplying fractions and does best when presented with information visually, whereas Ted has mastered fractions but does not understand inequalities and performs best when information is presented in auditory format. A successful example of personalization in action is New York City Department of Education's 2009 +



SOURCE: Roniesha Copeland, based on data from company websites and *Edsurge*, "The Edsurge Edtech Index," www.edsurge.com/products/, accessed December 2013. This was included as an exhibit in Harvard Business School note "Technology Innovations in K-12 Education."

pilot program School of One, which leveraged technology to create unique learning paths for sixth-grade students. Each path of daily tasks and activities was based on what the student had accomplished the day before and how that child had learned best. And lastly, the much-hailed flipped classroom is another technology-enabled personalization model in which teachers ask students to learn the lesson at home at their own pace by watching a video or completing exercises; classroom time is then used to give students individualized help in applying the concepts explained in the online lecture.

Productivity

A second challenge that many education technology companies are trying to address is productivity. Many entrepreneurs are exploring how teachers or districts can complete tedious tasks more quickly and efficiently in order to free up time for higher value-added activities that have a greater impact on student learning. For example, as software automates routine work such as grading or attendancetaking, teachers can spend that time exploring ways to better integrate opportunities for student discourse into their lesson plans. Tools that facilitate resource sharing can also increase teacher productivity and effectiveness: lesson-planning platforms allow teachers to learn from their peers and spend less time reinventing the wheel for every class.

Access

And lastly, many technology companies are trying to address a lack of access to resources. This effort can be discussed in relation to three different dimensions:

- Distance Technology is tearing down geographic barriers that stand in the way of learning. It can enable teachers to reach students who, due to location, may have previously lacked access to specialized instructors. For instance, technology can ensure that small districts in rural Minnesota are able to offer the same number of Advanced Placement classes as a large suburban district outside of Minneapolis.
- Time Learning no longer has to be confined to a predetermined school day. Online classes can help schools adapt to students' complex schedules. High school students with alternative scheduling needs can now view lectures on their laptops or mobile devices at a time convenient to them, for example.
- Cost Similarly, technology can lower financial barriers to resources. Students can access supplemental instruction available online, such as MOOCs (Massive Open Online Courses), which provide access to a wide array of courses. For example, students in Nebraska can now take Measuring Quantum Mechanics with MIT professor Barton Zwiebach at virtually no cost.⁹

Education Technology in Action: District Successes and Missteps

A handful of bold districts and charter schools around the country have been experimenting with implementing various types of technology in the classroom. The results have been mixed, but much can be learned from examining both the successes and failures.

The Successes

While the failures tend to dominate the narrative about education technology, there are districts that have modified existing instructional models and/or processes using technology and have met with success thus far:

• *State of Kansas* During the 2013-2014 school year, the State of Kansas embarked on a statewide initiative to personalize reading instruction with the goal of closing

their reading proficiency gaps. More than 225 K-5 elementary schools across the state participated in the initiative, in which a computer-based reading program provided personalized learning. Each student moved at his or her own pace through targeted, structured lessons. If a student struggled with a specific concept, the teacher was notified and would provide skill-specific, in-person instruction.¹⁰ Of the 11,000 participating students, 2,000 were considered to be at risk of not meeting grade level by endof-year benchmarks. By the end of the first year of the program, 90% of these struggling students had mastered more

struggling students had mastered more than one year's worth of content and 87% had advanced two or more grade levels. According to participating principal Ryan Cunningham, it was the best and easiest program he has used for identifying and addressing areas of struggle.¹¹ The Kansas Reading initiative is now entering its second year, with funding for 200 more schools to join the program during the 2014-2015 school year.¹²

• Middletown City Schools (NY) Middletown School District, an urban low-income district 70 miles north of New York City, used its Race to the Top grant to develop a new instructional model that would increase engagement and address the problem of ever-widening student ability levels. The district used a package of various software tools and digital content-the products that each student used depended on his or her specific need. At the end of the year, students in blended learning classrooms performed 57% better in reading and 26% better in math than their peers in non-blended classroom, and over 70% of students using the specified online curriculum progressed through more than one grade level in reading in one year.¹³ Of the participating teachers, 100% agreed that students in the blended classrooms were more engaged, and approximately 90 more teachers volunteered to become blended learning teachers for the 2014-2015 school year.14 "Blended learning... is quickly proving its instructional power when implemented with fidelity," said Middletown Superintendent Dr. Kenneth Eastwood.¹⁵

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> • West Ada School District (ID) Dr. Linda Clark, Superintendent of West Ada School District, has empowered teachers across her district to be part of the digital shift. Believing that teachers, the ultimate end-users of products, must have agency over choosing classroom technology tools, Dr. Clarke embarked on an internal research study in 2012 in which she gave five teachers the ability to redesign their classrooms. The participating teachers used a rotation-based blended learning model in which students moved across individual, group, and teacher-led activities. The district is seeing some early signs of success-Spring 2014 data from the MAP test (Measures of Academic Progress) showed strong evidence of increased percentages of students reaching or exceeding the growth targets in these classrooms. Additionally, evaluators have found that students in the tech-integrated classrooms are seeing a small to medium increase in engagement levels compared to that in regular classrooms, students are self-reporting that collaboration is much higher in the blended classrooms, and the participating teachers have reported lower stress levels. Empowering teachers to design and develop their blended programs has been a powerful approach in West Ada; the district has expanded its 21st-century classroom model to five entire elementary schools and to more than 100 other classrooms across the district.16 -

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The Missteps

While the success stories are exciting, not all forays into education technology have been as rosy. In any new endeavor, those who are bold enough to be among the early adopters often encounter challenges. An examination of some of the missteps can provide learning opportunities for other districts thinking about embarking on similar work.

• Los Angeles Unified School District (CA) In 2013, Los Angeles Unified School District embarked on a one-toone learning initiative that has perhaps become known as the biggest education technology "fumble" to date. The digital learning program was an effort to address what then Superintendent John Deasy called an important civil rights issue: "My goal is to provide youth in poverty with tools that heretofore only rich kids have had. And I'd like to do that as quickly as possible." The original timetable was to ensure every student across all 1,000 campuses had an iPad by the end of 2014. However, the first phase of the rollout to 47 of their campuses was riddled with challenges. The district faced a variety of security issues. Different tablets were configured with different security settings, and more than 300 students were able to easily bypass Internet filters. Additionally, parents were concerned about whether they would be held liable for iPad damages.¹⁷ Meanwhile, teachers and schools reported poor training and communication on how to effectively use the iPad in classrooms. As a result, the iPad and associated software ended up sitting under student desks or locked in closets. Mounting political pressure following a number of procurement controversies forced the district to eventually suspend any further technology purchases under the original contract.¹⁸ Los Angeles failed to address some critical details of the rollout, did not identify a clear instructional purpose for the technology, and did not provide sufficient training to teachers and administrators regarding the plan.

- Hoboken School District (NJ) Laptops currently lie discarded in the closets of Hoboken School District. Five years ago, the district received unexpected stimulus money and decided to use it to purchase laptops for the majority of its students-most of whom were under or near the poverty line. "We had the money to buy them, but maybe not the best implementation," said Mark Toback, the current superintendent. After the rollout, Hoboken classrooms quickly faced a host of unexpected technical problems everything from cracked screens to virus attacks. The IT department's time was spent dealing with laptop theft and Internet controls. Hoboken teachers also reported that the technical issues reduced real instructional time and teachers often had to deal with students that were distracted by solitaire and other computer games. Similar to the experience in Los Angeles, Hoboken had not articulated a coherent learning objective for its initiative.¹⁹
- Fort Bend ISD (TX) In 2012, the district set out to "transform classroom science teaching and instruction" using emerging one-to-one handheld technology. They planned to roll out an interactive science curriculum to second through eighth graders in an attempt to increase lagging science scores, and spent \$16 million to purchase 6,300 iPads.²⁰ An external audit of the initiative found that the program "fell short of its mission due to a combination of unrealistic goals, insufficient planning and project management, lack of consistency with existing Fort Bend ISD development standards, and poor contract management practices."²¹

Emerging Lessons

Through our research on education technology forays to date, our time in the field, and our intimate understanding of district operations, the District Management Council (DMC) has highlighted emerging lessons that we believe can help guide districts as they embark on incorporating technology to better serve the 21st-century needs of students.

Clearly identify the challenge you're trying to solve

As demonstrated by the challenges experienced in Los Angeles, Hoboken, and Fort Bend, it is important to articulate a clear and realistic

theory of action regarding how technology will drive student learning. That theory of action can then act as a "north star" as you formulate and implement the plan–it should guide everything from software procurement to teacher professional development. Another word of caution—a district's strategy is often significantly influenced by outside factors, such as the availability of federal grants or philanthropic initiatives. Yet, a district's plan should be focused on what is best for the district and what makes the most sense for students. Districts may be tempted to be opportunistic in the way they pursue technology, but should remember to stay focused on the district's needs and the most pressing challenges at hand.

Don't forget about the humans

If we are to glean any lessons from the mistakes of other districts, perhaps the most important is to anticipate the change-management obstacles that accompany any major new initiative. A computer with an Internet connection can be a very powerful tool, but only if facilitated properly by

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> teachers who are confident and comfortable with what they are doing and how they are to do it. Teachers have become accustomed to a certain classroom model—in fact, many may have joined the teaching profession precisely because of that lecture model. Given this background, it can take time and require ample support to ensure that teachers understand why they're integrating technology into the classroom and understand how to use technology successfully. If you want to see a boost in student achievement, you must build sufficient time into your plan for teacher training and opportunities for teachers to share knowledge.

Be strategic about resource realignment

Districts face a host of difficult budgeting decisions in a world of declining resources. It can be tempting for districts to manage budget gaps by delaying new investments, and it can often feel wrong to add new programs or make new purchases while also cutting the budget. However, more often than not, there are dollars available in the existing budget-districts just need to get creative in accessing them. For instance, many schools or districts may be able to reallocate the money spent on hardcover textbooks toward digital texts and online tools. States spend \$5.5 billion a year on instructional materials, yet many students are using books that are seven to ten years old. An advantage of digital content is that it can be updated easily without the cost of reprinting or redistribution.²² There are other potential cost savings, such as reduced copy and paper costs, and the use of online assessments. The Digital Textbook Playbook, a guide to help educators and administrators implement digital learning environments, →

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notes a potential \$600 savings per student from transitioning to a digital learning model.²³

Have the right decision-makers at the table

It is no secret that silos within a district can often waylay the best-formulated plans. Once a district formulates a theory of action around technology in the classroom, an appropriate cross-functional group should be convened to better understand how they can and must work together to accomplish the objective at hand. While the IT department has historically not been involved in instructional decisions, it is incredibly important that in this case the IT department have a seat at the table and a voice in formulating the strategy. By making the initiative cross-functional, the district will ensure that the right pieces are in place and that all stakeholders are moving toward the same end goal.

Poor IT infrastructure and technical glitches can foil even the best-laid plans

One of the biggest reasons the IT department needs a seat at the table is because, as demonstrated by the "missteps" above, the smallest technical glitches can foil the grandest of plans. It can be tempting for districts to get swept up in the glamour and excitement of education technology, but the devil is in the details. For instance, you can buy the best hardware and software and provide incredibly robust

training, but none of that will matter if your school does not have proper Internet bandwidth. In the Hoboken example provided above, the district had an unexpected problem protecting their Internet. "A lot of people knew the username and password," Superintendent Toback said. "So a lot of people were able to walk by the building and they would get wireless access. Over a period of years, you had thousands of people. It bogged it down, it made it unusable."24 Similarly, in Hoboken and the other examples above, IT support was paramount. The districts faced a host of technical glitches-everything from log-in challenges to broken screens. Nothing frustrates teachers more than lost instructional time. Districts must make sure they've fully prepared the IT staff for the array of technical challenges that a district can (and most definitely will) face in order to ensure that staff are able to provide rapid, in-classroom support to teachers when needed.

Measure your success

One of the most salient criticisms leveled at education technology is a lack of proven success. Sure, there have been pockets of success, but nothing on a large enough scale to allow us to say with certainty that technology in the classroom is good for students. Districts have a strong hypothesis for how technology will drive student learning–the only way to prove that hypothesis is correct is to test it and measure it. Applying a rigorous measurement framework will ensure that districts have the information necessary to either expand programs that are helping students or quickly abandon those that are not. When evaluating a technology program, DMC recommends the following guiding principles:

• *Measure the right things.* So often, schools measure their success based on process or satisfaction metrics (for example, the steps completed on the implementation of a certain initiative). While these process-oriented metrics may help you understand whether the initiative is on track, it will not tell you much about the initiative's efficacy. When measuring a technology initiative, districts must push to collect and measure outcome-oriented data that is directly tied to the associated learning objective, such as growth on formative academic assessments.

- Segment results by student. An examination of the type of data districts collect reveals that data is often tracked at an aggregate school or district level. In order to really understand what types of technology are working for what types of students, data has to be broken down at a student-by-student level.
- Develop comparison groups. Understandably, many stakeholders can find it "unfair" to roll out a resource to just a limited number of students. However, comparison groups are critical to ensuring that the program at hand is really making a difference in the lives of the participating students. Furthermore, when forming comparison groups, districts should ensure that the types of students in both the participating and the control group have similar characteristics that are important relative to the intended outcomes of the program.

Technology isn't just for the classroom

Finally, while lacking the allure of education technology for the classroom, management technology applied to school and district management may hold some of the greatest potential for gains in efficiency and improved operations.

In particular, management technology can help automate time-consuming processes and can help district leaders and administrators collect and analyze data in order to make more strategic funding decisions. Management technology helped a Midwestern district with roughly 5,000 students dive deep into the analytics of its busing routes, enabling the district to increase efficiency and free up more funds for teachers. The district had long used bus routing software to automate the creation of route lists for its drivers; this saved several days of administrative time, but not much else. Focusing on routing analytics, DMC pulled the data from the bus routing software and conducted paper surveys with each bus driver. The findings revealed that some bus routes could be consolidated because actual ridership was much lower than predicted ridership. The combination of technology and domain expertise freed up enough dollars in that district to save the jobs of five teachers.²⁶

Summary

Technology in and of itself is not a silver bullet, but it does have the power to enable a more student-centric and individualized type of learning. Yet, truly systemic and sustainable change of this sort requires leadership from the top. This leadership can come in many forms, but it is critical that centralized support, professional development, purchasing, etc., be coordinated by a core district team that has the clout to make an initiative of this scope successful. The Department of Education, recognizing the importance of leadership, recently sent an open invitation for superintendents from across the country to join the Future Ready District Pledge to commit districts to moving as "quickly as possible" toward the transition to digital learning.²⁷ In conjunction with the pledge, the department has said it will provide a variety of supports: the department agreed to support participating superintendents with dollars from the ConnectED initiative, the federal E-Rate program, and outside commitments from the private sector; promised to increase flexibility in the use of federal funds; and committed to providing implementation guidance and the creation of a superintendent mentoring network.²⁸ The momentum is now growing, and with the convergence of the variety of factors discussed here, there is real potential for education technology to finally begin to realize its promise for students and to help districts respond to growing demands, rising standards, and continued pressure on budgets.

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