More Productive Schools through Online Learning

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In October 2009 every public school in the state of Hawaii began closing on Fridays. For seventeen consecutive Fridays, stretching to nearly the end of the school year, Hawaii's public school students would not be educated. For those same Fridays public school teachers would not be paid. For the school year, students would receive 163 days of instruction instead of the normal 180, a 10 percent cut in their opportunity to learn. Teachers, who are paid on a longer year, would lose nearly 8 percent of their annual earnings.[1]

Like every American state, Hawaii was hard hit by the economic recession of 2009-2010. Business contracted, unemployment rose, tax receipts fell, claims for public services increased, and states were left with yawning budget deficits that required extraordinary measures to fill. California issued IOU's to taxpayers entitled to income tax refunds; the state simply did not have the funds to meet its obligations.[2] Education is the largest obligation in state and local budgets by far. While policymakers certainly strive to cushion children against the harshest consequences of economic downturns, the latest recession, the worst since the Great Depression, forced policymakers to cut back in schools like never before.

The District of Columbia Public Schools laid off 6 percent of its instructional staff. Schools Chancellor Michele Rhee made headlines by basing layoffs on performance rather than seniority—at least in part.[3] The departing teachers were alleged to be less effective than those who remained. The norm in public education systems, where employment practices are often reinforced by collective bargaining agreements, is to follow seniority. If cutbacks are necessary, the last hired are the first fired. The practice means that an energetic new teacher could be sacrificed for a burned-out veteran teacher. This is a stereotype, of course. Experienced teachers are often superior to inexperienced.[4] But blind adherence to seniority does not provide a school

with the most effective mix of talent. Throughout the nation, school districts let go thousands of teachers to weather the recession, and most reductions followed seniority.

Matters could have been much worse. The federal government sought to protect schools through the American Recovery and Renewal Act of 2009. Otherwise known as the "Stimulus Bill," the act provided public education nearly $100 billion in funds for 2009-2011, about four times the normal annual rate of federal funding. The funds enabled states to fill district budget gaps and limit layoffs. The results are still being tabulated; states are required by the law to document every job saved. No question, the recession could have hurt public schools—and yes, children—even more than it did.[5]

The pain for students takes many forms. Instructional staff who are not in regular classrooms are the first to go. Guidance counselors are often early casualties—a tragedy at a time when the nation, as President Obama has vowed publicly, aims to regain world leadership in college attendance. Librarians are another early target, which then limits student access to books and other media—at a time when literacy is our greatest educational challenge. Then teachers depart. The consequence is larger classes for students, taught by more senior teachers and fewer new teachers, none of which helps students learn.

And then there is Hawaii. The state negotiated its response to the recession with the Hawaii State Teachers Association. The teachers wanted to avoid layoffs, to keep good teachers on the island and available to help students when economic growth returns. They proposed, therefore, a furlough program in which teachers would not work 17 days and not be paid. The state would save, along with other cuts, enough to close its more than $200 million budget gap. Unfortunately, teachers cannot all be furloughed without closing schools. Students then suffer the ultimate consequence: they do not get educated.[6]

Learning from Hard Times

A deep and prolonged economic downturn is bound to cause hardship and force sacrifices everywhere. Public education could hardly expect to escape untouched. But if all that comes of this crisis are temporary measures and short-lived compromises, a huge opportunity will have been missed. Many industries use economic crises as an opportunity to look more fundamentally at how they do their work. Problems encountered in tough times are often the result of longstanding issues that required genuine adversity to be exposed.

The American auto industry produced too many similar models with too little quality at too high a cost, for many years. It had been losing market share to more distinctive, better engineered and more efficient imported cars since the mid 1970s. But good economic times allowed American automakers to pursue incremental improvements, without calamity. Then the recession of 2008-09 cost them nearly half of their sales. Facing bankruptcy, the industry sought government protection, while it made long overdue and wrenching adjustments, including eliminating whole brands, dealer networks and tens of thousands of jobs.[7]

Public education is arguably overdue as well. America spends more on public education than almost any nation in the world.[8] Whether measured as a share of Gross National Product or per pupil expenditures, spending on public schools in the United States ranks among the highest on the planet. Spending has also increased steadily for years. Even controlling for inflation, per pupil expenditures are double their levels of just twenty years past. Total spending now far exceeds a half trillion dollars a year, a sum that averages nearly $10,000 per student.[9]

For that investment, the United States obtains academic results that everyone agrees are not adequate. Achievement levels fall well below the top tier internationally. Only a third of American students, on average, achieve proficiency by our own national yardstick, the National

Assessment of Education Progress. The achievement of African American and Hispanic children trails that of white and Asian children by three grade levels. Dropout rates exceed 40 percent in most inner cities. College completion rates hover around 30 percent, as they have for a generation, behind some fifteen nations—with which we must compete economically.[10] One can quibble with any given statistic, but no one, Democrat or Republican, liberal or conservative, seriously disagrees with the overall picture: America's schools are not doing the job that the nation needs them to do.

They are also not doing well with the moneys afforded them. This is not a point of agreement. But on its face, it is true. The United States spends more on public education than most any nation. For that, the nation gets results that are mediocre at best. One can argue that the United States faces unique challenges of size, diversity and poverty. Or that America invests more than most in special education and social equity. And for these and other reasons the country must spend more on education to begin with. But it is increasingly clear that American taxpayers are not embracing more spending. They certainly did endorse tax increases to bail the schools out during the recession, despite the warnings of dire consequences. Public support for schools has been declining steadily for two decades.[11] Time will tell whether public schools are now at a cross roads, like the American auto industry. But the pressures for public education to reexamine its fundamentals have never been greater.

The Technology of Teaching and Learning

Seventy percent of school budgets are spent on instructional personnel. The bulk of that—half or so of the entire education budget—is spent on classroom teachers.[12] Schools systems, particularly large ones, employ lots of support staff who help classroom teachers. Special

educators, teachers of English Language Learners, trainers, coaches, counselors and various other experts help regular classroom teachers try to get the most out of their students. School budgets also include administrators in central offices as well as school facilities. It is easy to question the contributions of the "bureaucrats" or those educators who are not in the classroom. But the fact of the matter is, those personnel took on roles over time that were prescribed by policies or programs adopted by states, local boards of education, and sometimes the federal government—to help regular classroom teachers succeed where they had not been succeeding before.

That is right. The regular classroom teacher was not succeeding. With 25 (give or take) students, often of different abilities, sometimes with cognitive or language limitations, and needing to master reading, writing, math, science and social studies, the elementary school teacher was easily overwhelmed. At the secondary level, where subject matter becomes far more sophisticated, teachers specialized in particular disciplines, but they met multiple classes and took responsibility for 150 students at a time—with a wide range of skills and challenges.

Every school in the world struggles with the traditional model of classroom instruction. It is simply daunting for one individual to try to teach a large and diverse group of kids any subject to a truly high standard. Different nations have tackled the challenge in different ways—from using larger classes but better trained and compensated teachers, to employing smaller classes with more support personnel, to tracking students into more homogeneous classes of differing levels of difficulty. Each approach is constrained by public school budgets. No nation has unlimited resources to devote to education. Every solution is a compromise. Some nations have found better compromises than others.[13] But every nation is trying to solve the same problem: how to enable one teacher to help a large group of students learn, with finite resources.

This challenge has existed for as long as the technology of teaching and learning has been teacher-led large group instruction. But what if the technology could be different? What if the default mode of schooling was not students grouped into classrooms led by teachers, period after period, all day long? That is the promise of computer-based technologies, to enable schools to break out of the mold that shapes current practice most fundamentally. Schools that take full advantage of modern technologies—employing the Internet, information systems, and computerized instruction, among others—can transform their core economics and performance. In such transformation lies the potential for radical improvements for students and for taxpayers.

Online Schools

It is already possible for students to receive their entire education without setting foot in a traditional teacher led classroom. For the last decade, private companies, working with boards of community leaders, have developed charter schools that provide instruction, and other elements of a quality education, exclusively over the Internet. Roughly 100,000 students attended online or "cyber" charter schools full-time in 25 states in 2009.[14] Over a million students took at least one course online that year as well.[15] Online education is hardly confined to charter schools. Three-quarters of all public school districts offer some instruction online.[16] But to appreciate the potential of teaching and learning through technology, it is useful to consider those schools where the traditional classroom is simply not part of the equation.

Students Online

The promise of online education begins with what students can learn through technology. In a traditional classroom led by an accomplished teacher, students learn through a regular cycle of

instruction associated with each of a series of lessons. Consider the classic model.[17] Each lesson begins with some form of motivation. Teachers engage students by "activating prior knowledge:" they connect the topic of the new lesson to an earlier lesson and, ideally, to something to which students can relate in their lives outside of school or in current events. The teacher then explains the objective of the new lesson, and proceeds to impart the new knowledge or skill using whatever resources are available in a classroom setting—an old fashioned chalkboard or overhead projector, or a contemporary LCD projector or interactive white board.

Then it is the students' turn. The teacher first gives the students a problem or question with which to grapple collectively, and guides and challenges them to a solution. After that, the teacher provides an assignment which the students attempt to work through on their own, individually or in small groups, while the teacher supervises, coaches and helps students as questions arise. Class ends with a summation of what should have been learned. Homework is then assigned so students can practice further independently. Homework is later reviewed in class and after several lessons, a test or assessment determines what students have mastered.

This classic cycle of whole group instruction works well for many students but not for many others. Some students may not have comprehended prior lessons and therefore approach a new lesson with fear of failure. Some students may have struggled for years with fundamentals, such as reading comprehension, and look at every lesson as yet another in frustration. No matter how cleverly the teacher tries to motivate interest in the lesson, students who are behind will not be very motivated. If students begin lessons unmotivated, they will simply not make the hard effort necessary to learn.

In the traditional classroom everyone must move at the same pace. But, students who are already behind simply cannot keep up. If the teacher slows down for them, the others, especially

the most able, become bored or frustrated themselves. While state of the art presentation media can help teachers promote understanding of new concepts—better than a chalk board—teachers will still struggle to find the right mix of media to reach every student.

Then there is the students' own work. Student practice is critical; it is when students actually make knowledge their own. But practice must be carefully guided by teachers if students are not to make the same mistakes over and over. And teachers do not have the time to customize coaching for all students. Practice, then, does not produce mastery for many students, and quizzes and exams yield low or failing grades. Which leads to what? Is the next lesson delayed so that struggling students can catch up? Is the next lesson narrowed for slow students so they only have to learn the "essentials?"[18] There are no good answers. With whole group instruction, even extraordinary teachers will not be able to help every student succeed, especially if many students are underachieving. And, we cannot expect all teachers to be extraordinary. The problem is just that stark.[19]

Technology offers a solution. It begins with motivation. Students today are accustomed to using technology non-stop outside of school. Cell phones, text messaging, computers, the Internet, social networks, Skype, Twitter, video games, iPods, infinite "apps:" the ever changing tools of information technology are embraced by young people as fast as they are invented. The tools are ubiquitous, moreover. Disadvantaged city kids are as inseparable from their iPods and cell phones as more privileged suburban teens.[20] Cell phones become more like computers every day. Much technology requires little or no teaching. It is intuitive by design, but especially so for children who have known nothing but technology their entire lives.

Kids love technology. But schools have largely ignored this passion. School is the least technological time of a young person's day. Students power down when they enter school—lest

their cell phones be confiscated—and power back up when they leave. But technology can just as easily engage young people for educational purposes. The Internet is a rich research tool, of course. And schools generally do expect students to use it for the occasional paper or project. This only scratches the surface. The best new technologies can help students learn all the time. Instructional technologies mimic the technologies that students see outside of school. They include gaming environments, personal avatars to negotiate academic lessons, and social networks to connect students as they learn online. Familiar, easy to navigate interfaces allow students to get what they need to get—without raising their hand.

The best technologies are as captivating—and motivating—as the technologies that students use outside of school. Instructional software allows students to proceed at their own paces. Software is able to present new knowledge and skills in multiple ways. Students can read lessons or have lessons read to them, as they follow the highlighted text—a huge assist to students learning English or still mastering reading comprehension. Students can watch animations and videos that illuminate concepts or ideas—and as often as need be—surpassing what textbooks could ever do. Technology is interactive; students can manipulate mathematical equations, geometric objects, and the variables in scientific experiments, to name but a few, for hands-on experiences. Technology provides students more opportunities to learn. And, bottom line, success in learning is motivating. Students who have struggled and lost motivation in traditional schools can regain confidence and motivation by moving online.

Instructional technology not only allows students to move at their own paces in particular lessons. It allows students to get precisely the lessons that they need. In the critical area of literacy, for example, students at the same nominal grade level may have vastly different needs. Some fourth graders, who ought to be learning to appreciate the twists of story plots and the

morals of timeless pieces of literature, are often still hung up on decoding words. Software now offers powerful programs that enable students to sound out letter blends and whole words while voice recognition technology responds with corrections. Other programs provide higher achieving fourth graders the chance to read literature and non-fiction, both on grade level and above, and write essays that are graded by remote teachers online. A group of fourth grade students, whose diverse needs would otherwise be impossible for a teacher to meet, no matter how skilled at differentiation, could be satisfied simultaneously if all were able to work online.

Technology is superb at providing practice. The best software is not only able to supply students with almost endless problems to solve, fiction and non-fiction to comprehend, and questions to answer. It is able to provide quality feedback. Not the “good job” or “try again” of early instructional software, but explanations of why answers are wrong, how a distracter in a multiple choice question represents a common error, and how a problem or solution should be approached. The best software is also intelligent. It knows based on patterns of success or failure what concept or skill to teach next. It can customize remediation or acceleration, giving students what they need, not what the standard curriculum prescribes. It’s impractical for a regular classroom to provide the same opportunity for practice.

Nor for assessment. What happens when the weekly quiz reveals that some students have not mastered the material? Online, students are not evaluated merely every week. Their progress can be gauged lesson by lesson, day by day. Assessments can evaluate progress continuously. If a single student fails a single assessment, the online program can prescribe an intervention, perhaps additional work with instructional technology or tutoring with a teacher online. Online assessment is not limited, moreover, to closed-ended test items such as multiple choice, true/false and the like. Instructional technology makes full use of assessments requiring short answers,

essays, and research projects. The work is evaluated by live teachers who are also working online. Through open-ended expression, online assessment thereby facilitates higher-order thinking as well as the acquisition of more basic skills.

Teachers Online

In the brick and mortar school, the teacher performs many roles. Teachers must plan lessons, differentiate lessons, deliver lessons, write, administer and evaluate assessments, analyze student performance, plan and offer interventions and report grades. Teachers must take attendance, manage a classroom, establish relationships, serve as a role model, communicate with parents and otherwise attend to the social and emotional development of their students. They must attend faculty meetings, help plan team meetings, and contribute to the overall welfare of the school. No wonder teachers are often heard to complain that they barely have time to "just teach." The other tasks can overwhelm.

Technology can help with this. The benefits are clearest in online schools. A lot of technology use in traditional schools is supplementary—meeting needs for remediation or acceleration that whole class instruction has not adequately served. In online schools technology must carry the weight of delivering the instructional core—teaching, not just supplementing, Algebra I, Physics, Freshman English, and all the rest, indeed every subject from kindergarten through high school graduation. Online technology must therefore be rich in content and robust in scaffolding, to give students every chance to succeed with the software. The best online programs have every lesson expertly crafted and presented, and tightly tied to state academic standards. Assessments evaluate accurately the skills that need to be mastered. Technology analyzes student performance and specifies interventions when students fail a lesson the first

time. Of course, technology does the mundane work of taking attendance, documenting student effort (down to the keystroke), and reporting grades. The best online systems are designed to allow students to work asynchronously, meaning at their own pace and not tied to the work of teachers.

But where does that leave the teachers? Arguably doing what teachers do best. First and foremost, teachers teach. They teach whole groups and they teach individual students. Online education systems give students the option of working asynchronously or synchronously. Students can take an entire course working through online lessons, or students can participate in a live classroom watching and listening to a teacher remotely. Teachers are selected for this role (or select themselves) because of their skill at whole group instruction. The lesson is not simply a performance by the teacher; a lecture could be video-taped and shown without the benefits of online technology. But in modern online schools students can "raise their hand" electronically and ask questions, or the teacher can ask questions that students volunteer to answer individually—or are required to answer collectively, as in a "clicker" session in a college lecture hall.

There is an important difference, however, in online whole group instructors. Far fewer of them are needed. Experience shows that students are successful in online classes working more asynchronously than synchronously. Given the choice, students will complete three-fourths of their lessons without attending an online session with a teacher. Online classes can also be larger—roughly twice the size of traditional classes—because the teacher need not perform all of the traditional roles, such as classroom management, supervised practice and assessment. Online schools therefore require far fewer whole group instructors than brick and mortar schools, and—

this is the key—can be very selective in who teaches in this capacity. Online schools have a better chance, all things being equal, of providing their students effective teachers.

Whole group instruction is not the most common role, though, for teachers online. Most online instruction takes the form of one-on-one or small group tutorials. As students hit bumps in the road asynchronously, online assessment systems can flag the issue. If online interventions do not remediate the students' problems, the system can refer the students for tutoring. Students can also simply request individual help or join ongoing small group help sessions. While tutoring, the teacher can speak to the student online, exchange text messages (if the student is reticent), employ electronic white boards to illustrate concepts or solutions—just like in a classroom—or take the student back through the electronic instruction, with explanation. Online teachers regularly report that what they like best about the new medium is the one-on-one attention that they can provide their students—something they could not do very well in the traditional classroom.

Teachers can also devote more time to student work. Online schools often employ teachers as professional graders. The role might be performed in addition to tutoring, or it might be a sole specialization. Graders become expert at evaluating open-ended student work—everything from brief explanations to short essays to major research papers. Their job is to provide consistent and constructive feedback, the kind that helps students make progress with revisions and subsequent assignments. Open-ended assessment is a notorious problem in traditional schools. Teachers are prone to subjectivity, setting standards relative to class or school norms, judging papers based on their knowledge of the student producing the work, and struggling to guide improvement. "A" work in the inner cities, for example, often fails to translate into proficient scores on state assessments. Online graders have the training, time, and

accountability to evaluate objectively the work of students from many different communities. Graders report satisfaction in being better able to provide useful feedback.

Teaching and learning are not only cognitive processes, of course. Online schools recognize this. With students working remotely, and often from home, professional supervision of students can become a challenge. Some virtual schools have also handled this with a specialized teaching role. Students are assigned an advisor, who speaks with the family every week, monitors the progress of students in the electronic curriculum, ensures that interventions are provided when needed, and encourages the student to persist with lessons and keep pace. Performing only the role of advisor, this individual can be trained in the work of academic counseling and guidance, and support students without the competing demands of teaching.

With technology doing much of the heavy lifting of planning, presentation, assessment and reporting, teachers can focus on what real flesh and blood teachers can do best. They help students with the nuanced issues that impede their understanding, one by one. They can carefully evaluate student work that demands higher order thinking and guide real improvement. They can attend to individual student needs and counsel, with help from the family, thoughtful solutions. And, of course, they can just teach.

Online Performance

The potential of technology to enhance learning should be obvious. Technology can address all of the shortcomings of whole group instruction. Technology enables every student to participate effectively in the classic model of instruction: activating background knowledge, engaging and motivating interest, setting learning objectives and presenting new skills and knowledge, guiding practice, providing individual practice and feedback, assessing and, if necessary, re-teaching.

Technology provides students more mediums through which to learn. Technology allows teachers to take on more specialized and manageable roles online that take advantage of their unique skills.

The evidence thus far is that it is working. Asynchronous instructional technology is not new. Schools have employed it for nearly as long as the personal computer has been around. In the early 1980s, renowned Stanford University psychology professor Patrick Suppes developed one of the first intelligent tutoring programs. Commercialized by his Curriculum Computer Corporation, the program found wide use in schools serving Title I eligible students requiring remediation. Other programs quickly followed, developed and distributed by the major education publishers. As technology became more sophisticated, the programs added multi-media, simulations, voice recognition and ever more customized instructional algorithms. These programs addressed the traditional academic skills but expanded to treat various learning disabilities that responded to technology-supported training.

With nearly three decades of experience, instructional software has been the subject of extensive research. The evidence is that instructional technology is effective in raising student achievement. Not every piece of software, of course. But many programs have demonstrated significant effects on learning, and the overall approach to learning has been validated. But something has also been missing, and that is a tight connection between what students learn via technology and the skills that teachers try to impart in the classroom. Almost without fail, schools have asked students to go to computer labs to use reading, math and other programs, but done little to help teachers incorporate that experience into regular class expectations. Likewise, the computer programs have been unable to build directly on what teachers are doing in the

classroom. The result is weak "transfer" of skills learned using instructional software to the skills taught and assessed traditionally.

Until now. The breakthrough of modern online schools is the integration of quality software with live teaching and advising. The online school combines asynchronous learning using the latest generation of instructional technology with synchronous teacher-led instruction using educators in roles that complement the technology. Research has already demonstrated the educational potential of instructional software. Research is now beginning to address online education as well. The initial results are very encouraging, showing online courses to be just as effective as brick and mortar courses in raising student achievement.[21] This is remarkable given that integrated online instruction is relatively new, only a decade in large scale use—while traditional instruction has been around forever. Technology and its integration with live teachers will only continue to improve, as technology does inevitably.

Online Economics

As technology improves, it will not only become more effective educationally, it will also become more efficient. In schools, as in every other enterprise that technology has touched throughout history, schools will become more productive as they substitute technology for labor. Historically, schools have seemed almost immune to the technological innovations that benefited other industries. Indeed, efforts to make schools better have steadily made them more labor intensive and more expensive on a per student basis. As long as the "technology" of instruction was whole group and teacher led, the favored ways to pursue improvement were through smaller class sizes and more specialists to assist when whole group instruction came up short. Thus the frustrating economics of education: vastly more spending for barely better results.

This is about to change. Online schools already demonstrate how. Online schools may use educators in multiple roles: advisor, synchronous teacher, synchronous tutor, and asynchronous grader, to name only the obvious. But online schools rely on technology to do lots of the work that educators need not do—but traditionally carry out in brick and mortar schools. The result is that online educators can and do support many more students in their respective roles than their brick and mortar compatriots. Asynchronous graders may assess 200 or more students a semester—and still turn around grades more quickly, in say 48 hours, than they could in traditional classrooms. Grading is all that they have to do. Advisors can oversee the work of 60 students, including weekly contact with parents. This ratio, by the way, is several times *lower* than the ratio of high school guidance counselors to students in traditional high schools. Synchronous tutors can support 150 students, as the technology provides online interventions before teacher-led tutoring is required. Synchronous teachers can support over 200 students because only some students choose to take lessons directly from a teacher daily.

These ratios, which put students in touch with educators regularly in various ways, require far fewer teachers per pupil than brick and mortar schools. Different online schools use different configurations of educators, some with more differentiated roles, some with less. But however configured, online schools typically employ about 1 educator for every 35 students. Public schools employ 1 teacher for every 15.8 students and an even lower ratio if every instructional specialist in a school system is included in the total.[22] Conservatively, then, online schools employ about one-half the number of teachers per student as brick and mortar schools.

Labor is the biggest savings that online schools bring to education, though not the only one. Full-time online schools require smaller facilities than traditional schools because they must house only the school administrators and teachers, not the students. And schools have some

flexibility about even this cost because teachers can perform all or most of their work from home. Schools ask teachers to come to a common facility largely to collaborate, learn from one another, acquire professional development and coaching, and receive some measure of direct supervision. The work that teachers do with students does not necessarily require a facility.

Now, some online schools *are* required to bring students to a place for face-to-face instruction; a few states demand this. There is no evidence that this is "best practice;" it is more a provision created by opponents of online schools to make them more difficult to operate.[23] Online schools that serve state-wide populations, as most do, must then provide for student attendance at multiple sites throughout the state. This can be logistically onerous, and cut deeply into the facility savings that online education might yield. These provisions can also exclude many students—particularly rural ones—from access to online programs. Such requirements typically demand one day a week of physical student attendance. Assuming this as the maximum, online facility costs for educators and students attending part-time should not exceed about one-third of those of brick and mortar schools. This savings is complemented by transportation and food savings; if students only require a bus or meal one day a week, transportation (allowing for more sites and longer distances) and food service should cost no more than a fourth of the norm in traditional schools.

How do these savings add up? Traditional schools spend 52 percent of their budgets on instructional salaries and benefits.[24] Online schools should spend half that, or 26 percent of traditionally budgeted dollars. Brick and mortar schools spend approximately 15 percent of their budgets on facilities (capital and debt) and plant operations. Online schools should not exceed one-third of that, or 5 percent of traditional school revenues. Transportation and food average 7 percent of school budgets. In online schools those costs should amount to only 2 percent of a

brick and mortar budget. In total, brick and mortar schools spend 74 percent of their budgets on instruction, facilities, transportation and food—all areas in which online schools yield savings. Online schools spend 33 percent of the traditional school dollar this way, an overall savings of 41 percent against the traditional school budget.

That is an enormous savings.[25] It is not, however, the bottom line. Online schools of course also have expenses that traditional schools do not. Every student working online requires a computer and an Internet connection. Full-time online schools normally provide these. Traditional schools buy computers and wire classrooms too, but the student-computer ratio in public schools is 4:1, not 1:1, as in online schools. (And the federal government's "e-rate" program has paid to get nearly one hundred percent of America's public schools online.) Public schools spend about 2 percent of their budgets on computer hardware and connectivity. Online schools spend five times that.

Online schools have a vastly different instructional delivery system than traditional schools, which rely largely on textbooks, other physical assets, and software. Annual spending on such materials averages about 3 percent of school budgets. Online schools have some of these same costs. They frequently ship traditional instructional materials to student homes. (The largest online education company, K12, is notoriously diligent is this respect, even shipping families dirt for science experiments.) But online companies also have to provide robust technology platforms with learning management systems, assessment systems, online tutoring systems, portals for families, teachers and students, grade-books, and systems to report to multiple school districts, among others. These systems are more complex and expensive than the more limited information systems employed by school districts. Truly unique, online schools must provide a comprehensive curriculum electronically. The online platform and curriculum are licensed to

online schools from companies that invest constantly in their improvement. License fees run $2,000-$3,000 per student per year, or roughly 25 percent of a traditional $10,000 per student annual public school budget.

The additional costs of online schools are not small. Hardware, software, connectivity and other instructional materials may total 35 percent of a traditional school budget. Brick and mortar schools will spend only 5 percent in the same categories. That is 30 percent in extra costs in a full-time online school. But that is covered, of course, by a 41 percent savings in teachers, facilities, transportation and food. This is admittedly a rough calculation; costs and comparisons will vary with the grade levels served, the composition of student populations, and many other factors. There is some evidence that students with special needs are especially attracted to online schools, with their self-pacing, privacy, and multi-media solutions. These students are more costly to serve than regular students. If online schools need to meet some of their needs through face to face instruction, the logistics can be more expensive than in brick and mortar schools. Online schools have other unique costs, such as renting temporary facilities statewide to administer state standardized tests and marketing their services to families far and wide.

In the end, full-time online schools may be able to show a 10 percent savings over traditional schools. Many jurisdictions force online charter schools to operate with less than the full per pupil allocation to traditional brick and mortar schools or even the allocation to brick and mortar charter schools. Online charter schools now manage to operate in 25 states with differing limits on revenue. If even a few percentage points of savings could be multiplied against a public education budget exceeding a half trillion dollars, the total savings could run in the tens of billions. But the key point here is not the savings from full-time online schools. The key is the

vastly different allocation of the schooling dollar between technology and the traditional costs of education, and what that might mean for the productivity of public education.

Hybrid Schools

The future of technology and education is not one of students staying home to learn on computers supervised by parents. Full-time online schooling will work only for some families. The vast majority of families will want and need their children to be supervised and instructed outside the home. Most parents must work. Students also want to participate in group activities—sports, the performing arts, clubs, etc.—that schools provide easily. Community organizations can do many of the same things. But schools also facilitate the social and emotional dimensions of learning—working in teams, debating, participating in public, and other forms of social growth not offered by community groups or duplicated by interaction online. Simply put, most families will want their children to attend a physical school, and children benefit from doing so.

But schools of the future can and will be different. As the full-time online schools demonstrate so completely, students can thrive academically working online with both software and educators. Brick and mortar schools can take advantage of this—now. Students need not learn in whole-group, teacher-led classrooms, which does not work well for many students anyway. Students can take some or all of their instruction online, in a brick and mortar school. Schools can decide which students, at what age, and for which subjects, instruction is best delivered face to face or online. Advanced high school students might take the lion's share of their courses online. Elementary students needing remediation might spend a part of their day being assisted online. Schools might decide that courses that absolutely must be mastered by all students—perhaps, Algebra 1—will be offered online, so that students receive consistent

instruction and can proceed at their own pace, until proficiency is achieved. Schools might decide to use online instruction in classes for which quality teachers cannot be found. Or, schools might find that some students simply learn better online than traditionally, or vice versa, and assign classes on that basis. Classes can also be a mixture of online and face-to-face, a bit like college classes that include lectures and recitations. Technology offers the potential—right now—for schools to change the mix of traditional and online instruction to better meet the academic needs of students.

Student achievement must always be the goal. Yet, technology may also make schools more productive, getting more achievement for the same total expenditure or even a few dollars less. Here is how that can work in a hybrid environment. If students take courses online, they need not be supervised by a traditional teacher in a traditional classroom. Students can work on lap-tops in large open spaces like library-media centers, school atriums, and cafeterias, or in large computer labs. Spaces and supervision must be age appropriate, of course. On average, it is safe to assume that online instruction, where the school-based supervisor is *not* instructing, requires half to a third the number of teachers on site as traditional instruction. As schools adopt online instruction, they require fewer traditional teachers.

Consider a conservative model of what is now possible. Elementary students might work online one hour per day, middle school students two hours per day, and high school students three hours per day. Teachers might normally teach five hours daily and have one hour free, covered by another teacher (say, music, art or other electives). These work rules require that a six hour student day be covered by seven teachers, whether in secondary schools where students see different teachers each hour or elementary schools where students see the same teacher all day.[26] If online instruction is supervised in double-sized student groups in grades K-8 and triple-sized

groups in high school, the teacher savings are: for elementary schools 7 percent fewer teachers, for middle schools 14 percent fewer teachers and for high schools 29 percent fewer teachers.[27] Given the different numbers of years that each school spans, the weighted potential teacher savings across all grade levels is 15.4 percent. With schools spending 52 percent of their total budgets on instructional salaries and benefits, the teacher savings from online education could average nearly 8 percent annually—or $800 per student in a $10,000 per year school budget.

These savings come at a modest cost. Online course licenses average $200 per student per year-long course, and much less for instructional software programs. A 25 student online class costs a school $5,000, versus the $13,000 total cost (teacher salary and benefits, instructional materials) of a traditional one-hour class. In round numbers, the $800 per student that schools can save in teacher costs from a hybrid model nets to a savings of $500 per student after paying for software.[28]

The scenario mapped out here is a plan that public schools could implement right now. It requires no more computers or connectivity than schools have in place already. And it only begins to capture future savings. If students take more of their course work outside of brick and mortar facilities, working part-time from home and part-time at their hybrid schools, other education costs drop as well. Facilities might become smaller, plant operations cheaper. Fewer teachers would be required to supervise instruction. And over time, online schools are likely to become more efficient. As more students move online, technology firms will invest more in improving delivery systems and content, and prices will likely drop through competition and experience. Market forces are at work in the online world; they are largely not in the world of public education. If full-time online education costs 10 percent less than brick and mortar

education today, when the online industry is in its infancy, it is not unreasonable to conjecture a 20 percent differential as online education matures.

Productivity, Student Achievement, and Teachers

Online education and instructional technology can save public education money. To sum it up, a modest shift of schools from full-time whole group instruction to part-time online instruction can save 5 percent from current public education expenditures. That is approximately $30 billion a year that the nation could obtain right now. Full-time online schools, which may cost 10 percent less than traditional schools, currently serve only 100,000 students, or 0.2% of all public education students. That number could increase rapidly if states lifted the restrictions on online schools, which nearly all operate as charters. States and school districts offer individual courses online, but full-time, full-service online education is provided largely by charter schools, which most states restrict or prohibit outright. These limitations will fall as online education builds its own constituency and learning through technology gains acceptance. As students shift from full-time brick and mortar to part- or full-time online, public education will realize further savings.

But productivity is about more than obtaining the same results for less money. The history of productivity gains in other industries is one of both lower costs and higher quality, as technology substitutes for labor. The same will occur in education. Technology and online education have great academic promise because of the virtues of self-pacing, multi-media, instant assessment and intervention, and one-on-one attention from teachers. Working online should boost student achievement, even as it reduces costs.

The biggest boost in achievement may come the old-fashioned way. Online schools require half as many teachers as traditional schools. If the 100,000 students attending online

schools today were to grow to 1 million students (2 percent of all students), the nation would require 1 percent fewer teachers overall. If all public schools were to adopt a hybrid model of instruction, their teacher requirements would plummet—by another 15.6 percent. Take the two sectors together—full and part-time online—and the public education system might require over *16 percent* fewer teachers.

The importance of this savings cannot be overstated. Individual teachers are the single most important influence on student achievement, within the control of schools. (Home and family influences are also large, of course, but schools cannot affect them.) But with 3.8 million teachers in public education today and annual turnover rates of 10-20 percent, depending on location, public schools have a very difficult time finding and holding on to large numbers of high quality teachers. If schools had to employ 16 percent fewer teachers, the challenge of finding mostly high quality ones would be far easier. Imagine if schools could use this reduced need selectively, hiring only the best, and replacing the lowest quintile of current teachers—the truly unsuccessful. The benefits to students would be very large. Without putting to fine a point on it, if public schools required 600,000 fewer teachers than they do today—16 percent of the current total—schools could raise the overall quality of the teaching force substantially.

So technology has the clear potential to reduce costs, by 5 percent or more, without major investment or change in infrastructure. Technology also has the potential to improve achievement through the advantages of online instruction over traditional whole-group teacher-led instruction *and* by raising the overall quality of the teaching force. That's a clear productivity gain: more achievement at a lower cost. But there is even further potential, if costs were not reduced but kept constant. Savings from reduced labor requirements could be used to make other productivity investments. We know, for example, that teachers are the most powerful influence

on achievement. If technology reduces the need for teachers, the net savings after technology costs could be used to increase teacher compensation, offer performance pay incentives and make the job more attractive financially. In these ways, society can not only get more achievement for less expense, but even more achievement for the same investment as today.

This brings us full circle to the financial crisis in Hawaii and many American states. States are being forced to make painful and often unprecedented cuts in public education to weather the historic economic recession. States would do well to use this crisis as an opportunity to learn, and to look fundamentally at how education dollars are spent and students educated. Public schools currently make little use of technology to provide instruction. Indeed, public education discourages technology with laws that do not permit or under-fund cyber charter schools, that prohibit online teachers from teaching across state lines, that demand "seat-time" instead of proficiency to award credit for online classes, and that require online courses to be taken in whole or in part in brick and mortar facilities under the supervision of certified teachers—among other restrictions. Public education should eliminate these anachronistic restrictions and prepare schools for the future. If schools embrace technology, they can reduce their operating costs, help their students, and minimize the deep cuts that now jeopardize the opportunities for students to learn. Investing in technology is a sound investment, financially and academically, in the future of our students and our nation.

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[1] Gary T. Kubota, "Teachers Approve Contract," *Honolulu Star Bulletin,* September 23, 2009. Available online at *www.starbulletin.com.*

[2] "California: Now Issuing IOUs for Income Tax Refunds," *TurboTax Support*, July 15, 2009. *http://turbotax.intuit.com.*

[3] "DC Teacher Layoff Press Release," *D.C. Wire*, October 2, 2009. *www.washingtonpost.com*.

[4] The factors that predict and fail to predict teacher success have been the subject of more research than any other influence on student achievement. Representative studies include, Eric A. Hanushek, "Assessing the Effects of School Resources on Student Performance: An Update," *Educational Evaluation and Policy Analysis* 19, no. 2 (1997); Daniel D. Goldhaber and Dominic J. Brewer, "Does Teacher Certification Matter? High School Teacher Certification Status and Student Achievement,"

Educational Evaluation and Policy Analysis 22, no. 2 (2000); and Linda Darling-Hammond, "Teacher Quality and Student Achievement: A Review of State Policy Evidence," *Education Policy Analysis Archives* 8, no. 1(2000).

[5] *Economic Stimulus Package (ARRA) Guidance to Governors from Secretary of Education Arne Duncan*, April 1, 2009.

[6] Schools will try to cushion the potential blow to students with home assignments during days off; no educator wants students to lose. But everyone agrees the loss of in-school instructional time puts student achievement at risk.

[7] Ian McGugan, "Too Many Cars, Too Few Customers," *Financial Post*, November 21, 2009. Available online at *http://bxbusinessweek.comI*.

[8] International comparisons of education spending vary somewhat depending on which measures are employed. But, every analysis places the United States among the top spenders. See, for example, Michael Barber and Mona Mourshed, "How the World's Best Performing School Systems Come Out on Top," *McKinsey and Company*, September 2007.

[9] The latest figure reported by the federal government is for the 2005-2006 school year, when total public school expenditures totaled $529 billion. *Digest of Education Statistics 2008, Institute of Education Sciences, National Center for Education Statistics,* US Department of Education. Table 174. *http://nces.ed.gov/programs/digest/d08/tables/dt08_174.asp.*

[10] These well known indicators are explicated and documented in Terry M. Moe and John E. Chubb, *Liberating Learning: Technology, Politics, and the Future of American Education* (New York: Jossey Bass, 2009), Ch. 2.

[11] William Howell, Martin West, and Paul Peterson, "The Persuadable Public," *Education Next* 9, no. 4 (Fall 2009).

[12] The 70 percent figure is the sum of the federal accounting categories, "instruction" (51.9%) and "other school services" (18.3 %). *Digest of Education Statistics 2008, Institute of Education Sciences, National Center for Education Statistics,* US Department of Education. Table 174. *http://nces.ed.gov/programs/digest/d08/tables/dt08_17.asp.*

[13] The most successful is arguably the Japanese (and Asian) model of giving teachers larger classes but more time to prepare, fewer classes to teach and better compensation. See Harold W. Stevenson and James M. Stigler, *Learning Gap: Why Our Schools are Failing and What We Can Learn from Japanese and Chinese Education* (New York: Simon and Schuster, 1992).

[14] These schools numbered 219 in 2009, *National Charter Schools Directory,* The Center for Education Reform, Washington, DC.

[15] Sloan Consortium, 2009.

[16] Sloan Consortium, 2009.

[17] The classic model is due to Madeline Hunter. See, for example, Madeline Hunter, *Mastery Teaching: Increasing Instructional Effectiveness in Elementary and Secondary Schools, Colleges and Universities,* (Thousand Oaks, CA: Corwin Press, 1992).

[18] Lesson differentiation through methods such as "pyramid planning" is how teachers are taught to address the diverse classroom, but the methods inevitably compromise what some students can learn.

[19] The problem is perhaps best expressed in the "School of One" project launched by the New York City Public Schools in the summer 2009, to offer students fully customized instruction. The project, serving one pilot middle school, explains that even the most successful teachers in the entire school system fail to help a third of their students reach state proficiency levels in reading and math.

[20] Urban schools are as likely as suburban schools to have instituted policies to limit cell phone and iPod use during class time.

[21] Studies of online learning, covering many programs still in their infancy, find student achievement gains at least as strong as those in traditional settings. See, Rosina Smith, Tom Clark, and Robert L. Blomeyer, "A Synthesis of New Research on K-12 Online Learning," (North Central Regional Education Laboratory, November 2005); and Cathy Cavanaugh, et al., "The Effects of Distance Learning on K-12

Student Outcomes: A Meta-Analysis," (Naperville, Illinois: Learning Points Associates, North Central Regional Education Lab, 2004).

[22] *Digest of Education Statistics 2008, Institute of Education Sciences, National Center for Education Statistics,* US Department of Education. Table 63.
http://nces.ed.gov/programs/digest/d08/tables/dt08_063.asp.

[23] Terry M. Moe and John E. Chubb, *Liberating Learning: Technology, Politics, and the Future of American Education* (New York: Jossey Bass, 2009), Ch. 5.

[24] *Digest of Education Statistics 2008, Institute of Education Sciences, National Center for Education Statistics,* US Department of Education. Table 174.
http://nces.ed.gov/programs/digest/d08/tables/dt08_174.asp

[25] Details on technology spending in brick and mortar schools are discussed in Terry M. Moe and John E. Chubb, *Liberating Learning: Technology, Politics, and the Future of American Education* (New York: Jossey Bass, 2009), Ch. 4.

[26] Because teachers at all grade levels are given planning time away from students, the number of teachers needed to cover a student day exceeds the number of periods in a day: one teacher covers only five or six sevenths of a student day, the rest of the day must be covered by other teachers.

[27] In elementary schools, the single period of online instruction requires a half teacher (one teacher supervising two classes), a savings of .5 teachers from the total otherwise necessary of 7. A savings of .5 teachers from the total of seven is a 7 percent personnel savings. In middle schools the savings is double that, or 14 percent, because online instruction occupies two periods. In high schools, three online classes (rather than two) are supervised by one teacher, and online instruction occupies three periods per day. So the teacher savings equal 2/3 of a teacher for three periods or two whole teachers for every seven previously needed, a savings of 2/7 or 29 percent.

[28] The savings are calculated as follows. In the scenario in which online learning occupies 1 period in elementary, two periods in middle and three periods in high school, the savings in traditional teachers equals $800 per student. Since the cost of software for a single online class is $5,000 versus the $13,000 price tag of a traditional class, the online class is 5/13 the price of the traditional class per student. Applying a 5/13 software deduction to the $800 savings per student in our hybrid model yields a $500 per student all-in savings per student from hybrid instruction.