



Project Classroom Makeover

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SEE IT (VIKING, 2011).

The *Newsweek* cover story proclaimed, "iPod, Therefore I Am."

On MTV News, it was "Dude, I just got a free iPod!"

Peter Jennings smirked at the ABC-TV news audience, "Shakespeare on the iPod? Calculus on the iPod?"

The online academic publication *Inside Higher Ed* worried for our reputation. How would Duke University "deal with the perception that one of the country's finest institutions—with selective admissions, a robust enrollment, and a plush endowment—would stoop to a publicity ploy?"

And *The Chronicle of Higher Education* was apoplectic: "The University seems intent on transforming the iPod into an academic device, when the simple fact of the matter is that iPods are made to listen to music. It is an unnecessarily expensive toy that does not become an academic tool simply because it is thrown into a classroom."¹

What had these pundits so riled up? In 2003, we at Duke were approached by Apple about becoming one of six "Apple Digital Campuses." Each campus would choose a technology that Apple was then developing and would propose a campuswide use for it. It would be a partnership of business and education, exploratory in all ways. One university selected Apple PowerBooks loaded with iLife digital audio and video production software. Another chose e-portfolios, online workspaces where students could develop multimedia projects together and then archive them. Another selected audio software for creating audio archives and other infrastructure. What landed us in hot water was that, at Duke, instead of any of these, we chose a flashy new music-listening gadget that young people loved but that baffled most adults: iPods.

In 2003, the iPod did not have a single known educational app, nor did it seem to fall into that staid, stolid, overpriced, and top-down category known as IT, or instructional technology. Gigantic billboards had sprung up everywhere showing young people dancing, their silhouettes wild against brilliant bright backgrounds. What could possibly be educational about iPods? No one was thinking about their learning potential because they were so clearly about young users, not about IT administrators. That's why they intrigued us.

Our thinking was that educators had to begin taking seriously the fact that incoming students were born after the information age was in full swing. They were the last entering class who, as a group, would remember the before and after of the Internet. If they were born roughly in 1985 or so, they would have been entering grade school around the time that Tim Berners-Lee was inventing the protocols for the World Wide Web. These kids had grown up searching for information online. They had grown up socializing online, too, playing games with their friends online and, of course, sharing music files online. Categories and distinctions that an earlier generation of students would have observed in school and at home, between knowledge making and play, came bundled in a new way for this first generation of kids who, in their informal learning, were blurring that boundary. Their schools hadn't changed much, but at home, online, they were already information searchers. They had learned by googling. What if instead of telling them what they should know, we asked them? What if we continued the lesson of the Internet itself and let them lead us into a new, exploratory way of learning in order to see if this self-directed way might mean something when it came to education? What if we assumed that their experiences online had already patterned their brains to a different kind of intellectual experimentation—and what if we let them show us where the pedagogical results of such an experiment might lead?

From the way most schools operated in 2003—from preschool to graduate schools—you wouldn't have had much of an idea that the Internet had ever been invented. It was as if young people were still going to the library to look in the *Encyclopaedia Britannica* for knowledge, under the watchful eye of the friendly local librarian. Schools of education were still training teachers without regard for the opportunities and potential of a generation of kids who, from preschool on, had been transfixed by digital media.

The opportunity seemed to be staring us in the face. At home, five-year-olds were playing Pokémon every chance they could, exchanging the cards at

preschool with their pals, and then designing tools online to customize their characters and even writing elementary code to streamline their game play. They were memorizing hundreds of character names and roles and mastering a nine-year-old reading level just to play, but teacher training on every level was still text-based. It was as if schools were based on a kind of "hunt-and-peck" literacy, whereas kids were learning through searching, surfing, and browsing the Web. They were playing games in 3-D multimedia, learning to read and write not through schoolbooks but as they played games online and then traded their Pokémon cards with their friends.

When Duke announced that we would be giving a free iPod to every member of the entering first-year class, there were no conditions. We simply asked students to dream up learning applications for this cool little white device with the adorable earbuds, and we invited them to pitch their ideas to the faculty. If one of their profs decided to use iPods in a course, the prof, too, would receive a free Duke-branded iPod and so would all the students in the class (whether they were first-years or not). We would not control the result. This was an educational experiment without a syllabus. No lesson plan. No assessment matrix rigged to show that our investment had been a wise one. No assignment to count the basketballs. After all, as we knew from the science of attention, to direct attention in one way precluded all the other ways. So we asked our basic questions in as broad and open-ended a way possible: *Are there interesting learning applications for this device that is taking over young America as a source of entertainment?* And then the most revolutionary question of all: *What do you students have to tell us about learning in a digital age?*

If it were a reality show, you might call it Project Classroom Makeover. It was a little wild, a little wicked, exactly what you have to do to create a calculated exercise in disruption, distraction, and difference: a lesson in institutional unlearning, in breaking our own patterns and trying to understand more of the intellectual habits of a new generation of students and providing a unique space where those new talents might flourish. Instead of teaching, we hoped to learn. We wanted to tap into a wellspring of knowledge young people brought to college from their own informal learning outside of school. We didn't know what would happen, but we had faith that the students would come up with something interesting. Or not. We couldn't deny that failure was also a possibility.

At the time, I was vice provost for interdisciplinary studies at Duke, a position equivalent to what in industry would be the R & D (research and

development) person, and I was among those responsible for cooking up the iPod experiment and figuring out how it could work in the most interesting ways.² We wanted to stir up some of the assumptions in traditional higher education. We didn't count on causing the uproar that we did. We assumed some of our fellow educators would raise an eyebrow, but we didn't imagine an educational innovation would land us on the cover of *Newsweek*. Usually, if education is on the cover, it's another grim national report on how we are falling behind in the global brain race. Come to think of it, that *is* what the *Newsweek* cover story was about! Like Socrates before us, Duke was leading youth astray, tugging them down the slippery slope to perdition by thin, white vinyl iPod cords.

We were inverting the traditional roles of teacher and learner, the fundamental principle in education: hierarchy based on credentials. The authority principle, based on top-down expertise, is the foundation of formal education, from kindergarten playgroups to advanced graduate courses. At least since the GI Bill that followed World War II, and the rapid expansion at that time of the public university system, a college degree has been the entry card to middle-class, white-collar achievement. Not graduating from high school and lacking a college degree has constituted failure, and education has constructed its objectives backward from that (negative) goal, in some cities all the way down to competition for the right private nursery school.

What this means for young people who come to an elite private university is that they have taken one of a number of specific routes to get there. One way is to test to get into the best preschools so you can go to the best private grammar schools so you can be admitted to the most elite boarding schools so you can be competitive at the Ivies or an elite school outside the Ivies like Stanford or Duke. Another way is through public schools, a lifetime of determined and focused study, getting A's and even A+ grades in every class, always taking the most difficult courses, earning perfect scores on tests, and doing lots of extracurricular work, too. These students have been focused toward educational achievement their entire lives.³ We wondered what these astonishing young overachievers would do if given the chance not to follow the rules but to make them.

IN THE WORLD OF TECHNOLOGY, *crowdsourcing* means inviting a group to collaborate on a solution to a problem, but that term didn't yet exist in 2003 when we conducted the iPod experiment. It was coined by Jeff Howe of *Wired*

magazine in 2006 to refer to the widespread Internet practice of posting an open call requesting help in completing some task, ranging from writing code (that's how the open source code that powers the Mozilla browser was written) to creating a winning logo (such as the "Birdie" design of Twitter, which cost a total of six bucks).⁴ Crowdsourcing is "outsourcing" to the "crowd," and it works best when you observe three nonhierarchical principles. First, the fundamental principle of all crowdsourcing is that difference and diversity—not expertise and uniformity—solves problems. Second, if you predict the result in any way, if you try to force a solution, you limit the participation and therefore the likelihood of success. And third, the community most served by the solution should be chiefly involved in the process of finding it.

In the iPod experiment, we were crowdsourcing educational innovation for a digital age to our incoming students. We were walking the walk. Crowdsourced thinking is very different from credentialing, or relying on top-down expertise. If anything, crowdsourcing is suspicious of expertise, because the more expert we are, the more likely we are to be limited in what we even conceive to be the problem, let alone the answer. While formal education typically teaches hierarchies of what's worth paying attention to, crowdsourcing works differently, in that it assumes that no one of us individually is smarter than all of us collectively. No matter how expert we are, no matter how brilliant, we can improve, we can learn, by sharing insights and working together collectively.

Once the pieces were in place, we decided to take our educational experiment one step further. By giving the iPods to the first-year students, we ended up with a lot of angry sophomores, juniors, and seniors. They'd paid hefty private-university tuitions too! So we relented and said *any* student could have a free iPod—just so long as she convinced a prof to require one for a course and came up with a learning app in that course.

Does that sound sneaky? Far be it from me to say that we *planned* this, but once the upperclassmen coveted the iPods, once they'd begun to protest enviously and vehemently, those iPods suddenly tripled and quadrupled in perceived value: Everyone wanted one.

If "Shakespeare on the iPod" is the smirking setup, here's the punch line: Within one year, we had distributed more free iPods to students in forty-eight separate "iPod courses" than we had given without strings to the 1,650 entering first-year students.

That was vindicating enough, but it wasn't all. The real treasure trove was

to be found in the students' innovations. Working together, and often alongside their profs, they came up with far more learning apps for their iPods than anyone—even at Apple—had dreamed possible. No one has ever accused Steve Jobs of not being cagey, and Apple's Digital Campus strategy was an R & D winner. The company's flagship technology now had an active lab of students creating new apps for it. There was also plenty of publicity for the iPod as a potential learning tool—the teenagers of America should all thank us for making it easier to pitch the purchase to their parents. In the first year of the iPod experiment, Duke students came up with dozens of stunning new ways to learn. Most predictable were uses whereby students downloaded audio archives relevant to their courses—Nobel Prize acceptance speeches by physicists and poets, the McCarthy hearings, famous trials, congressional debates, or readings by T. S. Eliot or Toni Morrison, or Thomas Edison's famous recitation of "Mary Had a Little Lamb"—one of the first sound recordings ever made. Almost instantly, students figured out that they could also record lectures on their iPods and listen at their leisure. Classes from Spanish 101 to Introduction to Jazz to organic chemistry could be taped and listened to anywhere. You didn't have to go to the library or the language lab to study. You could listen to assignments on the bus, at the gym, while out on a run—and everyone did. Because everyone had the device, sound suddenly had a new educational role in our text- and visuals-dominated classroom culture.

Some version of this convenient form of listening was possible with that radical eighties technology, the Sony Walkman. But the Walkman connected to radio and to tapes, not to the World Wide Web, with its infinite amount of information ready for downloading.

Interconnection was the part the students grasped before any of us did. Students who had grown up connected digitally gravitated to ways that the iPod could be used for *collective* learning. They turned the iPods into social media and networked their learning in ways we did not anticipate. In the School of the Environment, with the encouragement of Professor Marie Lynn Miranda, one class interviewed families in a North Carolina community concerned with lead paint in their homes and schools. Each student would upload the day's interviews to a course Web site, and any other student could download and comment on the interviews. At the end of the course, they combined their interviews, edited them digitally, and created an audio documentary that aired on local and regional radio stations and all over the Web.⁵

Some med students realized that there was an audio library of all the possible heart arrhythmias, but no way to access it in a real-time health exam. They came up with a way to put a stethoscope in one ear, using very simple signal-tracking technology to match what they were hearing in the patient's chest to the cataloged conditions. The implications of this original use were obvious, and soon students studying to be doctors and nurses were "operationalizing" such techniques for the diagnostic use of doctors in rural North Carolina and Africa. Dr. Martha Adams, a senior administrator at the Duke School of Medicine, grasped how revolutionary it was to be able to make state-of-the-art medical research available to those far outside major research centers, and to also make it possible for doctors elsewhere to report on health problems and patterns they were observing in their own communities, thus advancing medical research in both directions. Soon she was working with the National Institutes of Health and leading a national outreach iPod initiative. Once again, attention was being focused in multiple directions at once, not just on outcomes but on process and on interaction, the mirroring happening (as it must, definitionally) in both directions.

In the music department, composing students uploaded compositions to their iPods so their fellow students could listen and critique. Music performance students inserted their voices or their instruments into duets or choruses or orchestras. You could listen to how you sounded as first chair in the flute section of a famous philharmonic orchestra. Students in Duke's engineering department had a field day mangling and dissecting their iPods to study (hack, some would say) everything from Apple's ultrasecret computer code to the physical properties of the famous white plastic exterior of the original iPods.

And they began exploring apps, developing applications that could be added to the iPod's repertoire of abilities without Apple having to give away its proprietary code. In other words, the iPod could still remain an iPod with its own distinctive characteristics, but it could change and morph as new features were added and new capabilities emerged, including some developed by users. To me, this was a conceptual breakthrough: that a commercial product might also be susceptible to consumer customization, a way of extending the infinitely changeable open-source properties of the Internet itself to a product with a far more fixed, finite identity. It was a hybrid of old and new thinking. If that isn't a metaphor for attention in the digital age, I don't know what is.

By the end of our first experimental year, Duke was part of a new movement

to transform the iPod from a listening device into an interactive broadcasting device. We were proud to host the world's first-ever academic "podcasting" conference early in 2005. I recently found one of our announcements for the conference and was amused to see those quotation marks around *podcasting*. No one was quite sure even what to call this new phenomenon, in which you could record a lecture, upload it to a Web site, and then anyone anywhere in the world could download it. Shakespeare on an iPod? Absolutely. And that lecture on Shakespeare delivered in the Allen Building at Duke could later be listened to by a student riding a bus in Bangkok or Brasília. That may not seem revolutionary now. It is hard to remember way back then, in the distant past of the Internet, before iPhones and netbooks, before MySpace and Facebook, and a full two years before YouTube was invented with its motto to "Broadcast Yourself."

The first podcasting conference drew standing-room-only attendance. It was sponsored by one of the first programs I'd spearheaded at Duke, something (another hybrid) called Information Science + Information Studies, or ISIS for short—artists and computer scientists, social scientists and engineers, and everyone in between in a new configuration. Lots of news media crowded into the auditorium at the Center for Interdisciplinary Engineering, Medicine, and Applied Science to witness the event. In a short span, the message had changed from "How could anyone possibly think this device could be used for learning?" to "This device facilitates sophisticated academic research and has the potential to make that learning instantly available to anyone in the world—for free."

The conceptual breakthrough of podcasting was access. It was expensive buying all those iPods, but the result was a breakthrough in education far beyond Duke, one whose purpose was to make a world of information cheaper to access than it ever had been before. With very little outlay, you had the potential of transmitting anything you heard, anywhere: You could download anything you heard worldwide. Not prerecorded programs made by professionals but content created and uploaded by anyone, ready for downloading—and for remixing and uploading again. When we launched the iPod experiment, no one expected that someday there would be an iTunes U (formed in 2007) with over 350,000 lectures and other educational audio and video files compiled by universities, libraries, and museums all around the world and available for download.

Duke took a lot of heat for being a "rich, privileged institution" that could afford this frivolity, but a revolution in the democratization of knowledge is not

frivolous, especially considering that, once customized, an individual mobile device is actually an inexpensive computer. Several years after the Duke experiment, in the fall of 2008, Culbreth Middle School, a public school in nearby Chapel Hill, North Carolina, created its own iPod program for an experimental group of staff and students. They chose the iPod instead of a more traditional laptop because of "the mobility of the device in one's pocket with instant access to information and apps."⁶ In January 2010, seventh graders were encouraged to explore the different ways their iPods could be used to keep them informed in the wake of the disastrous earthquake that brought destruction to Haiti. They used iPods to gather measurements of earthquake magnitude and related information, including demographic data, humanitarian assistance updates, local Haitian news podcasts, and historical information on Haitian culture and politics. The device also performed Creole-language translation. Students were even able to maintain up-to-date communication with a local graduate student who was in Haiti at the time and was badly injured in the earthquake. They used their iPods to educate themselves about a terrible disaster far away and produced their own podcasts from the information they gleaned. The experiment left little doubt that in the event of an emergency closer to home, students would be able to contribute their new knowledge to disaster-relief and fund-raising efforts locally.

The iPod experiment was not an investment in technology. It was an investment in a new form of attention, one that didn't require the student to always face forward, learn from on high, memorize what was already a given, or accept knowledge as something predetermined and passively absorbed. It was also an investment in student-led curiosity, whose object was not a hunk of white plastic, but the very nature of interactivity, crowdsourcing, customizing, and inspired inquiry-driven problem solving. At our most ambitious, we hoped to change the one-directional model of attention that has formed the twentieth-century classroom.⁷

THIS IPOD EXPERIMENT WAS A start at finding a new learning paradigm of formal education for the digital era. As we have seen, an infant's neural pathways are being sheared and shaped along with his values and his behavior in constant interaction with the people around him who exert influence over his life. The iPod experiment was an acknowledgment that the brain is, above all, interactive, that it selects, repeats, and mirrors, always, constantly, in complex

interactions with the world. The experiment was also an acknowledgment that the chief mode of informal learning for a new generation of students had been changed by the World Wide Web. It was an attempt to put the new science of attention together with the new digital technology that both demanded and, in some ways, helped produce it.

I'm not going to argue that the *interactive* task of surfing is better or worse than the reception model that dominated mass education in the twentieth century. "Better" and "worse" don't make a lot of sense to me. But there's a difference and, as we have seen, difference is what we pay attention to. Said another way, we concentrate in a different way when we are making the connections, when we are clicking and browsing, than when we are watching (as in a TV show or movie) or listening or even reading a book. Indisputably, the imagination is engaged in making connections in all of those forms, as it is in anything we experience. It is engaged in a different way when we ourselves are making the connections, when we're browsing from one to another link that interests us and draws our attention. We don't need a "better or worse" because we have both, and both are potentially rich and fascinating cognitive activities. But the relative newness of the surfing/searching experience drove our interest in the potential of the iPod experiment; in 2003, educators already knew how to mine traditional media, but we had not yet figured out how to harness the new forms of attention students who had grown up surfing the Web were mastering. The Web does not prescribe a clear, linear pathway through the content. There is no one way to move along a straight-and-narrow road from beginning to end.

The formal education most of us experienced—and which we now often think of when we picture a classroom—is based on giving premium value to expertise, specialization, and hierarchy. It prepared us for success in the twentieth century, when those things mattered above all. Yet what form of education is required in the information age, when what matters has grown very different? What form of education is required in a world of social networking, crowdsourcing, customizing, and user-generated content; a world of searching and browsing, where the largest-ever encyclopedia is created not by experts but by volunteers around the world—as is the world's second most popular Web browser (Mozilla's Firefox), the world's most massive online multiplayer game (World of Warcraft, with over 11 million subscribers a month), and all the social networking and communication sites, from MySpace and Facebook to Twitter?

Another way of asking the question is: How do we make over the

twentieth-century classroom to take advantage of all the remarkable digital benefits of the twenty-first century?

The iPod experiment was a start, but to get a sense of just how big a task we face, it's useful to have a sense of how schools came to be the way they are, shaped by the values of a very different world.

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Do you remember the classic story by Washington Irving, "The Legend of Sleepy Hollow"? It was written in 1820 and features a parody of the pompous schoolmaster in the form of Ichabod Crane, a homely, gawky, and self-satisfied pedant who is confident in his role as a dispenser of knowledge. He knows what does and does not constitute knowledge worth having and is equally sure that students must be drilled in that knowledge and tested to make sure they measure up. If you blindfolded Ichabod Crane, spun him around, and set him down in a twenty-first-century classroom, he would be baffled by electricity, dumbfounded by moving images, confused by the computers and cell phones, but he'd know exactly where to stand, and he'd know exactly where he stood.

It's shocking to think of how much the world has changed since the horse-and-buggy days of Sleepy Hollow and how little has changed within the traditional classroom in America. On March 10, 2010, the National Governors Association and the Council of Chief State School Officers even called for "sweeping new school standards that could lead to students across the country using the same math and English textbooks and taking the same tests, replacing a patchwork of state and local systems in an attempt to raise student achievement nationwide."⁸ Ichabod Crane lives!

What in the world is going on? In the past in America, times of enormous innovation in the rest of society, including in technology and in industry, have also been times of tremendous innovation in education. What has happened to us? Rather than thinking of ways we can be preparing our students for their future, we seem determined to prepare them for our past.

Literally. The current passion for national standards is reminiscent of the conversations on education at our country's beginnings, back in 1787, the year the U.S. Constitution was adopted. Technology was changing the world then, too. At the time of the signing of the Constitution, the new invention of steam-powered presses, coupled with the invention of machine-made ink and paper,

made for mass printing of cheap books and newspapers, putting print into the hands of middle-class readers for the first time in human history. The new institution of the circulating library made books available even to the working poor. Books proliferated; newspapers sprang up everywhere. And that's when a cry for standards and public education was born in America, in response to a new democratic government that needed informed citizens and new technologies of print that made books and newspapers widely available.

Thomas Jefferson himself advocated that America had to launch a "crusade against ignorance" if the nation was to survive as an independent representative democracy.⁹ By 1791, when the Bill of Rights was added to the U.S. Constitution, seven states were making provisions for public education. There was not yet anything like an "educational system" in the United States, though. Education was attended to unevenly by local, regional, state, and private institutions, some secular, some sectarian, an inheritance that continues to this day in the form of state-controlled educational policy, local and regional school boards, and other decentralized means of oversight.

Horace Mann, whose name can be found over the entrance of many public schools in America, was the first great champion of national educational reform. The son of a farmer of limited means, Mann clawed his way to an education, earning money by braiding straw to pay the local tuitions for the elementary schools he attended for only six weeks at a time, leaving the rest of his time free to help with family farming operations. He enrolled at Brown University at age twenty, graduated in three years as valedictorian of the class of 1819, and dedicated himself to the creation of the "common schools," which after around 1840 became the predecessor of a free, publicly supported education system.

The common schools were scheduled around the agricultural year so farm kids could attend too. The schools were open to both boys and girls, regardless of class, although several states explicitly forbade the attendance of nonwhite children. The schools were locally controlled, with the kind of local politics governing curriculum and textbook assignments then that we see now in the state-by-state regulation of education, even after our "national educational policy" has been adopted.

Mandatory, compulsory public schooling developed over the course of the last half of the nineteenth century and got its full wind at the turn into the twentieth century as part of America's process of industrialization. Public education was seen as the most efficient way to train potential workers for labor in the newly

urbanized factories. Teaching them control, socializing them for the mechanized, routinized labor of the factory was all part of the educational imperative of the day. Whether meant to calm the supposedly unruly immigrant populace coming to American shores or to urbanize farmers freshly arriving in the city, education was designed to train unskilled workers to new tasks that required a special, dedicated form of attention. School was thought to be the right training ground for discipline and uniformity. Kids started attending school at the same age, passed through a carefully graduated system, and were tested systematically on a standardized curriculum, with subjects that were taught in time blocks throughout the day. In ways large and small, the process mimicked the forms of specialized labor on the assembly line, as well as the divisions of labor (from the CEO down to the manual laborers) in the factory itself.

Many features now common in twenty-first-century public education began as an accommodation to the new industrial model of the world ushered in during the last part of the nineteenth century. With machines that needed to run on schedule and an assembly line that required human precision and efficiency, schools began to place a great emphasis on time and timeliness. Curriculum, too, was directed toward focusing on a task, including the mastery of a specified syllabus of required learning. "Efficiency" was the byword of the day, in the world of work and in the world of school. Learning to pay attention as directed—through rote memorization and mastery of facts—was important, and schools even developed forms of rapid-fire question-and-answer, such as the spelling bee or the math bee. This was a new skill, different from the elite models of question-and-answer based on the Socratic method; the agrarian model of problem solving, in which one is responsible for spotting a problem and solving it (whether a wilted corn tassel or an injured horse); and the apprenticeship model of the guild wherein one learned a craft by imitating the skills of a master. An assembly line is far more regular and regulated. One person's tardiness, no matter how good the excuse, can destroy everyone else's productivity on the line. Mandatory and compulsory schooling for children was seen as a way of teaching basic knowledge—including the basic knowledge of tasks, obedience, hierarchy, and schedules. The school bell became a symbol of public education in the industrial era.¹⁰

So did specialization. With the advent of the assembly line, work became segmented. A worker didn't perform a whole job but one discrete task and then passed the job on to the next person and the next and so forth down the

assembly line. The ideal of labor efficiency displaced the ideal of artisanship, with increased attention paid to the speed and accuracy of one kind of contribution to a larger industrial process. Focused attention to a task became the ideal form of attention, so different from, for example, the farmer on his horse scanning his land for anything that might look out of place or simply in need of care.

By 1900, state and regional schools were becoming the norm, replacing locally managed ones, and by 1918, every state had passed laws mandating children to attend elementary school or more. A concession was made to Catholics in that they could create a separate, parochial school system that would also meet these state regulations, another legacy that comes down to the present in the form of "faith-based schools."

During the first six decades of the twentieth century, as America ascended to the position of a world power, the rhetoric of education followed suit, with an increasing emphasis on producing leaders. While the nineteenth-century common schools had focused on elementary education, the twentieth-century focus was increasingly on the institution of high school, including improving graduation rates. In 1900, approximately 15 percent of the U.S. population received a high school diploma, a number that increased to around 50 percent by 1950.

After World War II, there was a rapid expansion of both high schools and higher education, invigorated after 1957 when the Russians surprised the world by launching *Sputnik*, the first man-made object ever to orbit the earth. As America competed against Russian science in the Cold War, policy makers placed more and more emphasis on educational attainment. Many economists argue that America's economic growth through the 1960s was fueled by this educational expansion.

Robert Schwartz, dean of the Harvard Graduate School of Education, notes that since the last quarter of the twentieth century, the pattern of educational expansion that has characterized the United States from the Revolutionary War forward has changed.¹¹ Since 1975, American educational attainment has leveled off or even dropped while there has been a dramatic increase in the number of jobs requiring exploratory, creative problem solving typically encouraged by postsecondary education. We are seeing the first signs that our education system is slipping in comparison to our needs.

The current high school graduation rate is roughly the same as it was in 1975, approximately 75 percent. Our graduation rate from four-year colleges is 28 percent, also roughly the same as it was thirty-five years ago. That this has

even remained consistent in the face of all that has changed in the last thirty-five years is remarkable enough, a credit to both the drive and quality of American students and the patchwork, piecemeal reforms we've used to hold the system together. Yet while we've been holding steady, other countries have made rapid gains. Whereas in the 1960s we ranked first in the proportion of adults with high school degrees, we now rank thirteenth on the list of the thirty countries surveyed by the Organisation for Economic Co-operation and Development (OECD), an organization that coordinates statistics from market-based democracies to promote growth. By contrast, South Korea has moved from twenty-seventh place on that list to our old number one spot.

Most troubling is what happened from 1995 to 2005. During this one decade, the United States dropped from second to fifteenth place in college completion rates among OECD nations. For the wealthiest and most powerful nation on earth to rank fifteenth is nothing short of a national disgrace. This is especially the case, given that our system of education *presumes* college preparation is the ideal, even in environments where most kids are not going on to college. By that standard, we are failing.

It's not that we cared about education before 1975 but don't today. Our heart is not the problem. Look at the numbers. The Swiss are the only people on earth who spend more per child on public education than Americans. According to OECD, we spend over \$11,000 per year per child on public education. That's more than double the rate of South Korea. Education spending accounts for more than 7 percent of our GDP.¹² However, the OECD statistics show that our graduation rates now are roughly on a par with those of Turkey and Mexico, not nations to which we like to compare ourselves by other indicators of our power or success.¹³

It is little wonder that educators and parents are constantly reacting to the comparative, global numbers with ever more strident calls for standards. The problem, however, is the confusion of "high standards" with "standardization." Our national educational policy depends on standardized tests, but it is not at all clear that preparing students to achieve high test scores is equivalent to setting a high standard for what and how kids should know and learn.

The real issue isn't that our schools are too challenging. It's the opposite. Among the top quartile of high school students, the most frequent complaint and cause of disaffection from schooling is boredom and lack of rigor. That also happens to be true among the lowest group, for whom low expectations lead to

low motivation.¹⁴ Kids aren't failing because school is too hard but because it doesn't interest them. It doesn't capture their attention.

Relevance has been proved to be a crucial factor for keeping students in high school, especially mid- and lower-level students. Tie what kids learn in school to what they can use in their homes, their families, and their neighborhood—and vice versa—and not surprisingly, that relevance kicks their likelihood of staying in school up a few notches. Because in the United States (but not in many countries with higher college attendance), going to college requires money for tuition, our emphasis on college as the grail of secondary education only rubs in its inaccessibility (its irrelevance) to lower-income kids—a fact that contributes to high school dropouts. Finally, for all groups, and especially for students in the lowest-achieving group, relationships with teachers and counselors who believe in them and support them (often against peer, familial, or cultural pressure) is a determining factor in remaining in school. These key factors for educational success—rigor, relevance, and relationships—have been dubbed the new three Rs, with student-teacher ratio being particularly important. Small class size has been proved to be one of the single most significant factors in kids' staying in and succeeding in school. Twenty seems to be the magic number.¹⁵ Even on a neurological level, brain researchers have shown that kids improve with directed, special attention to their own skills and interests, the opposite of our move toward standardization.¹⁶

The biggest problem we face now is the increasing mismatch between traditional curricular standards of content-based instruction and the new forms of thinking required by our digital, distributed workplace. At any level—blue collar or white collar—those jobs requiring “routine thinking skills” are increasingly performed by machine or outsourced to nations with a lower standard of living than the United States. Yet virtually all of contemporary American education is still based on the outmoded model of college prep that prepares students for middle management and factory jobs that, because of global rearrangements in labor markets, in large part no longer exist.

We've all seen industrial jobs for manual laborers dwindle in the United States and other First World economies, either taken over by machines or outsourced abroad to workers who are unprotected by unions or fair labor laws. The same is now the case for routinized white-collar office jobs. In exploitative “digital sweatshops” all around the world, workers at minimal wages can do everything from preparing your tax return to playing your online strategy

games for you, so your avatar can be staging raids while you are on the trading floor or in your executive office on Wall Street.

To be prepared for jobs that have a real future in the digital economy, one needs an emphasis on creative thinking, at all levels. By this I mean the kind of thinking that cannot be computerized and automated. This creative thinking requires attention to surprise, anomaly, difference, and disruption, and an ability to switch focus, depending on what individual, unpredictable problems might arise. Perhaps surprisingly, these noncomputational jobs, impervious to automation, occur at all levels across the blue-collar and white-collar spectrum. Many of these jobs require highly specialized and dexterous problem-solving abilities or interpersonal skills—but do not require a college degree.

We were criticized for the iPod experiment. Many treated it as if it were an extravagance, superfluous to real learning and real education. But the iPod experiment exemplifies a form of inquiry-based problem solving wherein solutions are not known in advance and cannot be more successfully outsourced to either a computer or to a Third World laborer who performs repetitive tasks over and over in horrific conditions at minimal wages. The new global economics of work (whatever one thinks about it politically) is not likely to change, and so we must. And that change begins with schooling. Learning to think in multiple ways, with multiple partners, with a dexterity that cannot be computerized or outsourced, is no longer a luxury but a necessity. Given the altered shape of global labor, the seemingly daring iPod experiment turns out actually to be, in the long run, a highly pragmatic educational model.

PART OF OUR FAILURE RATE in contemporary education can be blamed on the one-size-fits-all model of standards that evolved over the course of the twentieth century; as we narrow the spectrum of skills that we test in schools, more and more kids who have skills outside that spectrum will be labeled as failures. As what counts as learning is increasingly standardized and limited, increasing numbers of students learn in ways that are not measured by those standards. This is the lesson of attention blindness yet again: If you measure narrowly, you see results just as narrowly. In other words, the more standardized our assessment, the more kids fail. Their failure is then diagnosed as a learning disability or a disorder. But they are failing when assessed by a standard that has almost nothing to do with how they learn online or—more important—what skills they need in a digital age.

The mismatch is just wrong. It's as if we're still turning out assembly-line

kids on an assembly-line model in an infinitely more varied and variable customizing, remixed, mashable, user-generated, crowdsourced world. As long as we define their success by a unified set of standards, we will continue to miss their gifts, we will not challenge their skills, and, in the end, we will lose them from our schools just as, implicitly, we have lost interest in them.

We need far more inquiry-based opportunities for our kids. It doesn't have to be as expensive or as radical as the iPod experiment. The world is full of problems to solve that cost little except imagination, relevant learning, and careful guidance by a teacher with the wisdom to *not control* every outcome or to think that the best way to measure is by keeping each kid on the same page of the same book at the same time.

I recently visited a middle school where one girl with green- and blue-striped hair, creatively and eccentrically dyed, sat against the wall, remote from the other kids, as drawn into herself as she could possibly be without disappearing, looking for all the world like the kid who will never hear anything. When I, a stranger, came into the classroom, some of the other kids fussed over my unexpected appearance there, and my *difference*: One girl admired my purple leather jacket, another asked if I was an artist, because I was wearing a black turtleneck and skinny black pants. One boy asked about the image of an electric fan on my long, illustrated scarf from South Africa, and a waggish little boy hummed, with perfect pitch, "Who's That Lady?" when he saw me in his classroom. When I asked how in the world a twelve-year-old knew the Isley Brothers, he said snappily, "The Swiffer commercial." There was a lot of buzz in the class about the visitor, in other words. The green-haired girl in the corner slowly shifted her gaze in my direction, gave the smallest upward movement at the corner of her lips before returning to her frown and letting her eyes move back to outer space again, away from the strange visitor, determinedly *not there*.

I thought of a blog post I'd read earlier that week by the prolific business writer Seth Godin, creator of the popular user-generated community Web site Squidoo. Godin's post was called "What You Can Learn from a Lousy Teacher," and his list of what you can learn from the teacher you cannot please included: "Grades are an illusion, your passion and insight are reality; your work is worth more than mere congruence to an answer key; persistence in the face of a skeptical authority figure is a powerful ability; fitting in is a short-term strategy, standing out pays off in the long run; and if you care enough about work to be criticized, you've learned enough for today."¹⁷ This remote young woman

against the wall didn't look defeated by school. There was something *resolute* in her. I could sense that she had, somehow, taken in intuitively the kinds of lessons Godin was preaching, even if it would take her another decade to fully realize what, in her body language, she was already showing she'd absorbed.

She stayed that way, barely making eye contact with the teacher or any other students, until drawings begun during the previous class were handed around to be worked on again. The transformation I witnessed then was so rapid and thorough that I thought of what Pygmalion must have seen the first time his statue came to life. She went from being still, glassy-eyed, self-contained, and entirely not-present to a concentrated, focused, dedicated bundle of intensity. She still didn't interact with the other kids, but all eyes were on her as she began her day's work on a highly detailed line drawing she was executing. Unlike the bustle at the other tables in the room, there was a silence around her, with the kids practically tiptoeing into the circle of her aura to watch, not speaking to her or to one another, then moving away. I was dying to see her drawing but even more interested in the compact energy she'd created around herself and the other kids, generated from the passion of her drawing. Rather than interrupt that magic, I moved away.

Later in the day, I saw her waiting for her ride home, in the homeroom period at the end of the day, and again the sullen remoteness of I-am-not-here returned. After all the kids had gone, I asked her teacher to tell me about her. She'd been diagnosed as profoundly learning disabled, with attention deficit disorder. Her parents sent her to this magnet arts school after she had failed elsewhere. At home, the only thing she seemed to enjoy doing was doodling, but her elementary school had laid off its art teachers, sacrificed to educational cutbacks and the fact that, in our standardized forms of testing, there is no EOG (end-of-grade exam) for art. Art is therefore an add-on that many public schools cannot afford. It was only at the new school that her skills as an artist were recognized. She quickly went from the class failure to the class artist. She mastered the editing tools on the class computer and transferred her imagination and creativity there, too, much to the admiration of her classmates.

I think again about what learning disabilities signify for kids today. In the *Diagnostic and Statistical Manual of Mental Disorders* (the infamous DSM), attention deficit disorder is characterized by distractibility, frequent switching from one activity to another, boredom with a task after just a brief time trying to execute it, and difficulty organizing and completing a task or in focusing on

a task in which one is not interested. That last phrase is key. ADD almost never applies to *all* activities, only those in which the child is not interested. This isn't a disability (a fixed biological or cognitive condition) but a disposition (susceptible to change depending on the environment). Keep the kids interested and ADD goes away.

The girl with the green hair has special skills that show up nowhere on her compulsory EOG state tests, on which she continues to score poorly. "Your work is worth more than mere congruence to an answer key." This girl's talents don't count on those tests, and yet she has a special and valued ability that cannot be replaced by a computer program. The problem is that her fate is to a large extent controlled by her performance on the EOG tests, and unless the adults in her life—teachers and parents—are resolute in shepherding her along a path where her talents are valued, they may ultimately wind up undeveloped.

I identified with this girl. When I was in school, my talents had been math and writing, and there was a teacher, Miss Schmidt, who saw those gifts, despite my abysmal test scores, despite the fact that we had to memorize the preamble to the Constitution and the Gettysburg Address to graduate from eighth grade and I just couldn't. I tried and failed over and over many times, staying after school, trying to say it out loud and failing again. Miss Schmidt was feeling certain that I wasn't really trying but just being "obstinate." Then, during one of our painful after-class sessions, she had a hunch. She offered me the opportunity to write an essay instead, one essay about each brief text I was failing to memorize. I stayed up all night working on this and returned the next day with my project. My scrawl filled every page in a small spiral binder—*two hundred pages*.

I remember her eyes widening as she took this smudgy, worn binder from my hand. She looked through it in disbelief and bewilderment as she turned over pages and pages of my barely readable handwriting. There were even footnotes. "You still don't have them memorized, do you?" Miss Schmidt asked. I shook my head. After a moment, she got out the special state certification and, beside my name, put the check mark I needed to graduate from middle school. I'd passed.

Sometimes you learn from the good teachers too. It's not easy to be a good teacher all the time. The girl with the green hair was lucky to find one who honored her talent. Before I left his classroom, I told him, if he thought it appropriate, to let the girl know that the visitor, that professor from Duke University, had noticed her beautiful artwork and admired it. I told him, if he

thought it appropriate, to let the girl know that, when the visitor was her age, her hair was purple.

AS MATTHEW B. CRAWFORD ARGUES in *Shop Class as Soulcraft*, his eloquent study of the importance of making and fixing things, our national standards for secondary schools miss kids like this young lady. Our schools are geared, implicitly and explicitly, to be college preparatory. They are weighted toward a twentieth-century, white-collar, middle-management economy.¹⁸ Our standardized education not only bores kids but prepares them for jobs that no longer exist as they once did. Attention blindness again. Our one-size-fits-all educational model focuses steadily and intently on the past.

The space age was America's educational glory moment, when we occupied the number one spot. At that moment, there was a splendid flowering of many kinds of educational theory, including progressive theories, free schools, Montessori schools, science and technology schools, new math, old math, and on and on. It was thought that we were facing a brave new world of science for, after all, incomprehensibly, men had walked on the moon. Education took that fervor to its heart, blossoming, experimenting with innovations as bold and expansive as the solar system itself.

Now, in a digital age, we can communicate and learn in ways not even imagined by Neil Armstrong and Buzz Aldrin walking for the first time on the face of the moon: "One small step for man, one giant leap for mankind." Yet our educational vision has shrunk to the tiny bubble of a multiple-choice exam. Our dreams of new standards of knowledge have shrunk to the right or wrong answer, chosen not among infinitely variable possibilities but among A, B, C, D, and, perhaps, none of the above.

I hate this kind of education. I'm prejudiced, I admit it. So don't ask me. Ask any adult. Ask yourself. What was the most formative experience of your life in school? I suspect your answer isn't "I scored in the 94th percentile on my fifth-grade end-of-grade compulsory exam." Whenever I ask this question, invariably I hear a story of a great teacher who had faith, who inspired and challenged someone to do more than she ever thought was possible before.

Ichabod Crane may nod approval at our current national educational policy. It may seem familiar to him and right. For those of us who remember what inspired us, what commanded our attention, there was always something experimental and daring, there was always something more.



Some of the best teaching I ever witnessed did not happen courtesy of the Internet. It was many years ago, in rural Alberta, Canada. Inez Davidson, the mother of my first husband, Ted, began her teaching career at eighteen, teaching in a one-room schoolhouse in Pincher Creek, a coal-mining town in the Canadian Rockies. She rode half-wild horses to school each morning, alone in the dark and the cold through grizzly country, "putting miles on them," as she would say, before they could be sold to local ranchers as well-trained working horses. Inez was maybe five feet tall, but no one messed with her, ever.

Ted's father was a rancher in the town of Mountain View when he married Inez. Mountain View is as pretty as its name, a gorgeous ranching community in the foothills of the Rockies. The Davidson homestead looked out upon Chief Mountain, the sacred mountain of the Blackfoot and Blood Indian tribes. The area was made up mostly of Native peoples and Mormons or adamant ex-Mormons like the Davidsons, plus elk, moose, black bear, grizzlies, mountain lions, and so forth. Two hundred people in two hundred square miles. The area was poor, too. Rural electrification only came to Alberta in the late 1950s. Even in the 1970s and 1980s, when I was there, the kitchen had a stove that also burned wood (for when the electricity went out), and the entire house had only two additional propane heaters. This was *Canada*, in the foothills of the Rocky Mountains. In winter, it was sometimes 20 or 40 degrees below zero. The hallways and bathrooms and bedrooms were unheated. There was an outhouse for when the plumbing was overtaxed. It was a lot for a gal from Chicago to take in.

My mother-in-law taught in the three-room schoolhouse in Mountain View. For many years, there were more former residents of Mountain View with PhDs, MDs, or law degrees than from any other town in Alberta besides the two major cities in the province, Edmonton and Calgary. By the time I came on the scene, graduate students earning their degrees in education departments in the province were coming to Mountain View to find out what was happening there, that such a backwater was sending students not only to college but well beyond.

Mrs. Davidson, as she was called, was a main reason for this educational success story. How did she do it? First, she got in a lot of trouble, every year, with the school superintendent because she refused, ever, to teach to a test. She covered what the province demanded of third, fourth, and fifth graders and far

more, but she always did it her way, as a challenge, a game, an interactive and communal learning activity. She made learning fun—and she was tough.

She was very skeptical of the concept of learning disabilities. She taught long after the normal retirement age and began to see kids coming to school who were more hyperactive than she'd seen in her earlier career and was convinced that part of the reason was environmental and part behavioral. She was concerned about both food additives and contaminants in the air and drinking water even in cattle country, where the water supply was tainted by runoff from oil and smelting plants far away. She was also shocked at how parents were driving kids to school instead of having them walk or ride horses in; these were forms of physical exercise she believed were important to kids' health, well-being, and concentration in the classroom. She loathed it when she saw kids medicated as a remedy for their learning disabilities, and was much more interested in all the subtle and obvious ways kids learned—and learned differently.

She insisted that everyone had a unique way of learning and believed that to be true of the smartest students as well as the academically weakest. She took pride in finding challenges that inspired kids who had clear cognitive restrictions or physical ones, and defied anyone to bring her a kid she couldn't teach. Rodney, a close friend to all the Davidson boys, was a brilliant athlete but very poor in school. Reading was hard and math unbearable. He couldn't conceptualize arithmetic on any level and used his fingers to count even the simplest arithmetic. Other teachers wrote him off as "slow." Mrs. Davidson bought him an abacus and had him research all the sophisticated things the ancient Egyptians could calculate on one. She then taught him to use the different parts of each of his ten fingers as if they were beads on an abacus. He could put his hands under the table and, without anyone seeing, do "rapid calculation" instantly. He did so as a kid, acing math tests, and he did so as an adult, gaining a reputation for uncanny speed and accuracy in the brawny, take-no-prisoners arena of the cattle auctions. Rodney was no one's fool.

Two of Inez Davidson's best teaching tricks involved games. One was that, on every Friday, she would divide up the kids, the fifth graders on one side of the room, the little kids—third and fourth graders—on the other. Whatever they had learned that week would be the subject of the Friday contests. The first part of the day would be spent with the previous week's winners figuring out what kind of competition they would make. They would devise the rules and explain them to the other group. The competition would then require one group testing

the other on the answers to various problems in all the different areas they had studied that week.

Mrs. Davidson would serve as the referee. The little kids worked hard to beat the older kids, who of course had their honor to defend, and each team tried to ask harder and harder questions to stump the other. Once Mrs. Davidson felt that the week's work had been covered, she would declare a winning team. The winning group could head out to the playground fifteen minutes early while the losers sat there an *interminable* fifteen minutes—nine hundred seconds!—getting a head start on next week's contest. Some weeks, though, they had so much fun scheming on the hard questions they'd ask the following week that Mrs. Davidson would have to point to the clock to remind them that study hall was over and that it was time to go outside to the schoolyard to play with their friends.

Sometimes they had an hour of these competitions on Friday, sometimes two hours. The other teachers grumbled that Mrs. Davidson's kids got away with murder. Ted, who had his mother as a teacher for all three years because there wasn't anyone else in Mountain View, ended up winning a full scholarship to the University of Chicago, where he tested out of virtually all of his first- and second-year college courses. Not bad for a kid from a cow town in the Canadian Rockies.

Mrs. Davidson taught her kids to dream. Every year, there would be some new, ambitious project with a theme that would unfold over the course of the year. One year, the project was for each child to find a pen pal in another town called Mountain View somewhere in the world. There was only one map in the school, so a first step was to take an enormous piece of newsprint, cover the map, and spend days and days tracing out all the countries on their own map. Then, each child went to the library, which held far fewer books for the entire school than my study holds today, and they each started reading about all the countries in the world, looking for other Mountain Views. They would then mark their particular Mountain View on the hand-drawn map tacked up in the schoolroom. They had to think of ways to communicate with kids in these other Mountain Views. Since this was a Mormon area, there were families who had been on missions to other parts of the world, so that was the obvious way to make contacts, but this was a contest, and ingenuity was rewarded.

One kid remembered that Hang Sang, the elderly Chinese man who ran the local general store, the only store in town, had come over to Canada to work

on the railroad, as had so many Chinese immigrants. Taciturn, with a thick accent, Mr. Sang was amused and delighted when one child suddenly wanted help writing a letter—in Chinese. The kid had somehow found out about a town called Mountain View in China. That was the child who won the contest, and long after the contest was over, he spent time with Mr. Sang, talking to him in the back of his store.

But of course they all won. The globe became smaller through the connections they made, and their town became larger. They learned geography and anthropology and foreign languages too. The project lasted not just one full year but many years, and some kids visited those other Mountain Views when they grew up. To this day, I don't drive through a town named Mountain View (there are a lot of them in the world, actually) without wondering if one of Mrs. Davidson's kids sent a letter there and, through the connection made, was inspired to go on, later, to become a professor or a doctor or a veterinarian.

None of what happened in Mrs. Davidson's classroom in Mountain View, Alberta, Canada, depended upon an iPod. None of it required the Internet. But the Internet requires this kind of interactive, motivated, inspired, and curious form of learning. The key here is that Mrs. Davidson's classroom was not really divided up into "subjects" so much as it was into problems, puzzles, brain teasers, challenges, games, word problems, and intellectual obstacle courses, many of which require kids working together toward a solution. What counts is the little kids showing, with pride, that they are every bit as smart as the big kids and the big kids showing, with pride, that they are king, and all of them understanding (although they'd fight you rather than admit it) that they need one another to learn and to dream.

Like the iPod experiment, what this classroom story shows is that kids want to learn and can propel themselves to all kinds of learning as long as there is a payoff, not in what is won or achieved in statistical terms, but what is won and achieved inside, in the sense of self-confidence and competence. Learning, in this sense, is skill and will, an earned conviction that, faced with a challenge ahead, this past achievement will get one through. You can count on your ability to learn, and nowhere is that more important than when what you've learned in the past no longer suffices for the future. That is the glistening paradox of great education: It is not about answering test questions. It is about knowing that, when tested by the most grueling challenges ahead, you have the capacity to learn what is required to succeed.

It is in this sense that unlearning is a skill as vital as learning. It is a skill you have to acquire, too. Unlearning requires that you take an inventory of your changed situation, that you take an inventory of your current repertoire of skills, and that you have the confidence to see your shortcomings and repair them. Without confidence in your ability to learn something new, it is almost impossible to see what you have to change in order to succeed against a new challenge. Lacking confidence in your ability to change, it's much easier to blame the changed situation—typically, new technologies—and then dig in your heels, raising a bulwark against the new. Confidence in your ability to learn *is* confidence in your ability to unlearn, to switch assumptions or methods or partnerships in order to do better. This is true not only for you, as an individual, but for whole institutions.

That's what those kids in a tiny town in rural Alberta learned as fourth and fifth graders pitted against the six graders (and vice versa). Mrs. Davidson had to fight the school superintendent every year. Her kids all knew that, too. They knew that she'd put herself on the line for their learning; she'd stand up to anybody, including the superintendent, on their behalf. She dared him, year after year, to fire her. In a different era, he might have, but every year, there'd be the ritual dressing down in his office. I was never in the room with them, but I have a feeling that it wasn't Mrs. Davidson who left feeling chastised.

Put those kids in a lecture hall, give them a standardized curriculum with standardized forms of measuring achievement and ability, and they learn a different lesson. They might well master what they are supposed to learn, but that's not education. When you think of learning as something external to yourself, learning becomes a levy—an *assessment*, not an *asset*. The assessment no longer matters after the schooling stops. The asset is a resource one draws on for a lifetime.

How can the lessons of this woman's extraordinary classroom be put to use? The model of learning in Mrs. Davidson's classes is probably as old as human history. It is the game. As in a game, there are parameters, what you need to know in order to succeed within the game's rules and requirements, subject matter, or methods. There is a specific target or goal, and you compete with others and against others to win. The real winner, always, is you, not because you earned the trophy but because you learned the inestimable skill of responding to a challenge.



The Dark Knights of Godzilla sit, furrow-browed, poring over an ingenious series of cogs and ramps dwindling down to a small slingshot. They are devising a mechanism to power their machine. It's hard enough to do onscreen, when they are playing the video game *LittleBigPlanet* (LBP) on their PlayStation 3's, but now they face a boss-level challenge: They have to engineer an actual starter mechanism in real life, in the school lab. They have to take it from a blueprint all the way to completion in plastic, wood, and rubber, and then demo it in front of everyone.

That's what a boss-level challenge is in the gamer world. It is the last big test of your group. It is your way to show your stuff, to put together everything you've learned about working together, so you can move on to the next level.

Across the room, the I Don't Knows are transfixed by C-clamps, hacksaws, and wood saws. They made their Rube Goldberg contraption from cardboard and tape, but it fell apart, so they are calculating tensile strength, experimenting this time with wood and wood glue.

Vamelepiremenest ("the *t* is silent") takes a break from the *awesome* building project they are contemplating in order to feed Ameer's turtle some lettuce and tomatoes. Ameer's own Home Base has dozens of parts arrayed on the lab table. Maybe a robot isn't the right way to go for an automated device to power a faucet?¹⁹

These are eleven-year-olds, seventy-two of them in sixth grade at Manhattan's Quest 2 Learn (Q2L), a public middle school where all classes are taught on gaming principles. To succeed at the boss-level challenge, students must make actual, physical constructions based on two months of playing LBP, the popular video game that bursts with quests and gizmos and characters that you customize and guide through an elaborate maze of obstacles. The kids have been learning Newtonian physics as they work their avatars—Sackboy and Sackgirl—higher and higher through the game play, and now, as a final quest, they have to actually design and build ramps and faucets and page turners in the real world. They are taking the action off the screen and now designing and engineering the mechanisms in real life, all working together in teams. This is the last assignment before winter break at Q2L.

Q2L is the brainchild of Katie Salen, a game designer and a professor at

Parsons The New School for Design, a university-level art school in New York. A tall, athletic-looking redhead who has written books on the importance of games for learning, Salen likes to talk about the “ecology” of gaming, from “code to rhetoric to social practices.”²⁰

I am mesmerized when Katie speaks. I first met her around 2005 when I became part of the Digital Media and Learning Initiative at the John D. and Catherine T. MacArthur Foundation. They’re the philanthropic foundation that gives the “Genius Awards” every year. The Digital Media and Learning Initiative is dedicated to promoting innovative ways to energize kids to learn. Katie presented the foundation with an outlandish proposal. Why not make a school based on the principles of games and gaming, on strategy and problem solving? Why not keep an eye out for bright kids who have been failed by conventional schooling? And the hardest challenge of all: Why not make this a public school? To make a point about the validity of games as an exceptionally challenging and rigorous learning method, she wanted her school to be college prep in its emphasis but to be open to accepting bright students who seemed to have learning disabilities, trouble in school, or other issues that might normally preclude them from a college-prep track. I must admit, I was skeptical. We all knew she had her work cut out for her. But Katie is a gamer and a game designer, and with all the doggedness of someone working to achieve a new level, she set to work on school boards and bureaucracies, rules and regulations, parents and principals. She did not stop, and a few years later she got her school. I don’t know a better object lesson in how a gamer learns to get things done.

It has been gratifying to watch her success, and thrilling, too, to be able to sit back and see the world shower its appreciation on this great accomplishment. In fall of 2009, Quest 2 Learn opened its doors with an inaugural class of sixth graders. A partnership among Parsons, New Visions for Public Schools (an educational reform group), the Institute for Play (a nonprofit dedicated to game-based learning), and the Department of Education, Q2L garnered so much interest that it needed a lottery to select its first class. Serious games, serious fun, serious learning: That’s Q2L’s business.

The conjunction of strategy, fun, and learning makes games particularly rich for education. Kids at Q2L don’t just learn math, for example. They learn to act like mathematicians, both in the video games they play and customize and create, and in the real world outside the game. They use math principles to create a gizmo that will open a book. Or they learn the mathematics of a

Möbius strip that they will then shape into fashion, such as the adjustable shoulder strap of a purse they design and make.

As Salen notes, the concept of gaming extends far beyond stereotypical video games in the same way that the concept of learning extends far beyond the standard configuration of a classroom or a multiple-choice test. "Gaming is play across media, time, social spaces, and networks. . . . It requires an attitude toward risk taking, meaning creation, nonlinear navigation, problem solving, an understanding of rule structures, and an acknowledgment of agency within that structure, to name but a few" of the basic elements of games.²¹

Just ask Lesli Baker, whose eleven-year-old son, Beauchamp, was diagnosed with attention deficit disorder. After difficulties at previous schools, the family applied for Q2L. He was one of the seventy-two kids to win the lottery and be awarded admission. It took a "leap of faith" to put him in a school based on games, but, his mom says, "It's a great match for him. He's really enthused about learning."²²

And what exactly might Beauchamp be learning? Are you skeptical about how much kids can really learn playing games? Here's a sample of this week's blogs by his teacher, Alicia, at Q2L:

This week . . . we continued our Mini-Quest from Arithmus, this time showing the twins that we could multiply and divide with integers. . . . We also finished our training around "About or Exactly," which dealt with place value, rounding and beginning estimation. . . . We were then ready to crack the second piece of Prof Pie's Perfect Pie Recipe! This time Pie told us he had written his code in something called a key word cipher. We studied and practiced with key word ciphers and worked to complete the encoded message so we could figure out what page to scan next. . . . Next week we will begin a quest around parts of speech and how they connect to our language of code.

Integers and grammar and computer code are all part of the same quest. Interestingly, these kids are not only tested by each boss-level challenge in their game worlds, but they also take all the tests required of sixth graders in public school by New York State. Those year-end tests are another boss-level challenge for which they are preparing.

What is obvious from Quest 2 Learn is that the school has taken the

lessons of attention to heart. The game-based learning makes for a constant challenge, one calibrated to the individual child's learning abilities and progress, each level becoming more challenging after the previous one has been mastered, with constant disruptions and shifts, not from topic to topic but with all forms of knowledge integrated to the ultimate test: the boss-level challenge!

ALTHOUGH ONE IS HIGH-TECH AND one was in a one-room schoolhouse without electricity for much of its existence, the Quest 2 Learn classroom has much in common with Mrs. Davidson's schoolroom in Mountain View. Both, in different ways, are based on the same experimental, student-driven lessons in attentive learning that were at the root of the iPod experiment, and both have almost nothing to do with Ichabod's rote form of education. Intrinsic to inquiry-based learning, there's a "gamer disposition," which is to say a real commitment to learning that goes far beyond school to the cultivation of "risk-taking, critical reflection, collaboration, meaning creation, non-linear navigation, problem solving and problem definition, and innovation."²³

Seeing new options is precisely what this world of gaming is about, and so is collaboration. These kids are learning their subject matter. They aim to go to college one day—but they are also learning invaluable skills that will serve them in the twenty-first-century world of constant change. They are interested, motivated, and challenged, and are learning the lesson that it is great to work hard at what you love most. *Liebe und arbeit*, as Freud said, "love and work," the keys to a successful life. In any century.

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As I think back to my own childhood misadventures in learning, the insufferable torture of those interminable days in school, as I think of my son, Charles, now a lawyer with his own practice, whose life in school was no more endurable than my own, I have to believe Q2L has found an infinitely better way for kids to learn. Check out their curriculum and you see that they are hitting all the bases. They offer assessment, standards, and an explicitly college-prep program: Everything is undertaken with the goal of going to college. Yet many of their students have learning disabilities and have failed in other public schools. They seem to be thriving here. And, better, they are *learning*.

E. O. Wilson, the distinguished professor emeritus of biology at Harvard,

thinks so too: "Games are the future in education. I envision visits to different ecosystems that the student could actually enter . . . with an instructor. They could be a rain forest, a tundra, or a Jurassic forest."²⁴

That's right. They could explore together a terrain where all the forms of knowledge and play and social life and team-building and even "wellness," as it is called at Q2L in sessions at the start and end of each day, go together. And in a way kids love. Not all schools can be designed like Q2L, but that doesn't mean that the principles embodied here can't be embraced by more typical schools. So that raises a question. To appreciate how far Q2L has come, we need to look at the methods and challenges of a typical public school in America today.

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It doesn't snow all that often in North Carolina, but when it even looks like snow, the local schools close down. One recent winter it snowed a lot. There weren't other forms of child care. One of my coworkers had to figure out where her nine-year-old daughter could spend the day. Fortunately, we had the incomparable Sackboy and Sackgirl, the heroes of LittleBigPlanet, at the ready to perform as virtual babysitters.

Not a lot of university profs have a Sony PlayStation 3 set up in the office, but I am also the cofounder of a virtual organization called HASTAC, a network of educators and concerned others dedicated to new forms of learning for a digital age. HASTAC is a long acronym that stands for Humanities, Arts, Sciences, and Technology Advanced Collaboratory. Everyone just says "Haystack." We were gearing up for a new HASTAC/MacArthur Foundation Digital Media and Learning Competition. It's fun to give away \$2 million a year to educators, entrepreneurs, and software developers for coming up with creative new ways of learning. That year, for one part of the competition, we were partnering with Sony and Electronic Arts to challenge competitors to come up with ways of turning commercial games that kids love into inspiring platforms for learning. If it seems to you that this is a bit like the old iPod experiment, you're right.

On this snow day, three nine-year-olds, a boy and two girls, spent the day—the entire day—playing LBP, with the occasional Cheetos break thrown in for good measure. By the end of the day, they were sweaty faced, excited, with the glazed and glassy eyes that you see in nineteenth-century illustrations of opium eaters. When they packed up their things to go home for the night,

I intercepted them, eager to hear all that they had learned in a day of the kind of interactive, challenging game play that we were pushing as the next frontier of learning.

"What did you learn today?" I asked.

"Learn?" They dissolved into helpless, hysterical laughter.

"You didn't learn anything?" I asked again, a little pathetically.

"No! No!" They laughed some more. "No way!"

They were adamant. They had just had the greatest day of their lives. How could they possibly have *learned* anything?

I said good-bye and went back to my office, wondering how we had failed. Three smart kids, and they hadn't realized that they'd spent a day making Sack-girl and Sackboy succeed against all kinds of odds, requiring ingenuity, basic science knowledge, collaborative team-building skills, and other marks of what, in our competition, we consider to be imaginative (and reimagined) learning. Apparently, their idea of learning was rather different from ours.

After letting myself feel discouraged for a little while, I decided it would be useful to visit their school to see why what they had done that day couldn't possibly be conceived of as learning. Thanks to my friend David Stein, the senior education partnership coordinator at Duke whose Duke-Durham program works in conjunction with public schools near the campus, I was able to visit several schools in town, including the school a little further away that these three kids attended. This school seemed to have nothing to do with the kind of utopia of learning games envisioned by Katie Salen and others. This school was not close enough to be part of the Duke-Durham partnership, although the principal I met clearly was eager to make that connection or to partner with another institution of higher education or a supportive local business or community organization. He said over and over how much difference even a modest boost in attention, resources, special programs, and volunteer teacher's aides could make to a school like his. Duke is a wealthy university in a poor and valiant town with its own unique history. Durham was once called the "Black Wall Street," when it was the center for black banking, insurance, and investment businesses under segregation, and the city has a history of a strong black upper-middle class and a proud African American working class too. Connections with the local schools and the local community are fostered at Duke and considered as important to the learning of Duke students as they are for Durham's aspirations.

The school the three kids attend is a magnet school featuring the arts and humanities. It is also officially deemed to be a “failing school” by the national standards-based educational policy known as No Child Left Behind. For the sake of privacy, we’ll call this school Middleton Elementary. Everyone—the principal, the teachers, the parents, the children—is ashamed of its failing status.

Middleton’s student body is a mixture of middle-class kids, a few children of professors and graduate students, and kids whose families live on exceptionally modest means or worse. Nearly 60 percent are on what in North Carolina is called the “free and reduced lunch plan,” meaning the family income is so low that the federal government covers their lunch costs. Racially, the school mirrors Durham itself, in being roughly divided among Caucasians, African Americans, and Hispanics. As a magnet school, kids have to enter a lottery to get in, and parents tend to be more involved than at some public schools.

The physical building looks almost identical to the middle school I attended as a child—cinder-block construction, one story, long central corridors, smaller hallways to the sides. Like my own school, this one was built in the early 1950s, as part of the post-World War II baby boom. Everyone here is excited that a new building will be opening soon, but even in the meantime, I’m impressed that there is art everywhere on the walls—and it is good. The level of sophistication, both the talent of the kids and their knowledge of art history, is astonishing. Third and fourth graders do paintings in the style of Picasso, Kandinsky, Romare Bearden, and others. It is Black History Month, and the walls are adorned with photographs, quotations, and drawings from the civil rights movement, as well as lots featuring President Obama. This place has an undeniable spirit. It is trying hard not to fail.

However, there is also a palpable and off-putting rigidity and discipline, which makes the school very different from our day playing LittleBigPlanet. Kids walk single file in the halls, their hands clasped behind their backs. When David remarks on this “old way” of doing things, the principal is defensive, answering that he’d like to do it another way but he has to make sure the kids stay focused, that they do not waste a minute of precious class time. Implicit in the comment is the ever-present challenge the school faces. The kids have to pass their end-of-grade exams. The school can’t afford to fail again. In the classrooms, the desks are crowded together in tight rows. The class size is in the high twenties and even thirties. The teachers wear determined expressions, intense as they look out over rows and rows of children.

Because they are a "failing school," they have to get 100 percent of their test scores up to the required standards by 2014, or under the provision of the national policy, the school will lose its public funding and will no longer be able to operate as a public school. It will either be shut down or privatized (put into the hands of a private for-profit oversight firm). Middleton has a special challenge. Durham was once a city that was only black or white, but it now has a sizable population of immigrants from Latin America. About a third or more of the kids at the school do not speak English at home. For many, an indigenous language like Quechua is spoken there, with Spanish as a second language. Yet they must take their end-of-grade exams in English. By state policy, there are no provisions for non-English testing. By what logic would failing a test in a language other than the one spoken in your home constitute a failure for you as well as for your teachers, your classmates, and your entire school? That is the burden I feel, despite the exuberant walls, despite the efforts of teachers who care and parents who do too.

I swear you can hear the word *failing* being whispered in the halls. There is a determination here that moves to the other side of *rigor*, close to *rigid*: There are EOG tests that *must* be passed this year. Or else. As kids walk between classes, in single file, their hands behind their backs, I can almost see the weight of this national policy bearing on them. This feels nothing at all like the playful day at our office, getting Sackboy through various levers and gears, over this and that obstacle, calculating how much effort it will require for him to swing over this or pass under that and deciding whether it would be better to just make a running leap to the next platform rather than trying to use a tool to make that happen. There's not much here like Mrs. Davidson's school in Mountain View.

These kids sit mostly in rows. I see one of the girls from our snow day sitting in her classroom. Her back is to me. She is looking intently forward. She's very smart, a very good student. I hate to say it, but she looks bored to death, nothing like the ball of energy she was on snow day.

On the door of the kindergarten class, there's a sign. It doesn't say "Welcome!" It doesn't say "Learning is fun here." The sign sets out the rules for "how to get along" in the classroom. "Do not talk. Do not hit. Do not eat. Do not chew gum." Most of the kids are too young to actually read, so I assume this sign is as much a symbol as it is a message. It is conveying an attitude of constraint and discipline. In this school, we pay attention by making rules, by fear,

by rote, by paying attention to the teacher. This is what learning is. No wonder the kids on snow day felt as if they'd been granted a reprieve.

I hasten to add that once one moves past the unwelcoming sign, there is a lot of love in the kindergarten classroom, and there's a teacher trying very hard to do the right thing. She doesn't want this school to fail, her kids to fail.

She probably earns about \$30,000 a year (the average starting salary for an elementary school teacher), and I'm guessing she uses some of that to buy school supplies for her students. Almost half of all new teachers leave the field within five years. The drop-out rate of teachers is a bigger crisis in this country than the drop-out rate of our high school students. It is *tough* being a teacher. Personally, I'd rather dig ditches than spend my days with eighteen little kids and my evenings on the phone with irate parents sure that I'm shortchanging their little Johnny and Janey. The current punitive attitude toward teachers is just plain offensive. *You* try being an elementary or high school teacher for a day and tell me how it goes!

As the principal was proudly showing us his school—and there was much to be proud of—I gently noted the negatives on that sign. He gave no indication of hearing, but a few weeks later, when a friend happened to be back at the school, she noticed the poster I'd mentioned at the front of the kindergarten, the one that said "Let's Get Along." The rules on the poster were different: "Use kind words. Be quick to forgive. Listen. Share. Encourage others. Take turns. Think before acting. Talk it over." Had my simple words made a difference? Or did the teacher have two different signs and I'd only seen one? I have no idea, but I was pleased to learn about the more positive message on the second sign, amid the same border of happy smiling rainbow children who, in fact, looked pretty much like the rainbow kids at this school.

When it snows again in North Carolina, the kids are ecstatic at the idea of another day joining Mom at our office, another day laboring away at LBP. This time, we're determined to ruin their day just a little by having them think about what they're learning. (I know, I know.) We rephrase the question. We tell them that we are running a competition where people will be able to create learning challenges for LittleBigPlanet. We need their help. Can they tell us about learning, what they are learning when they play?

Question and answer. We're a culture good at questions and at answers. It's two girls today, and they squirm with delight and rise to the challenge, as surely as they've maneuvered adorable Sackperson through numerous "platforming

scenarios" (parched Mexican deserts, austere Japanese gardens, bustling New York City streets) using what the manufacturer calls "its robust physics engine." For the kids, it means making Sackboy or Sackgirl run, jump, push, and grab.

"So the way it's learning," one of the girls begins, her voice dropping with the seriousness of the task she's been set, "is because you learn *structure*." She lets the impressive word hang there a moment. She has our attention. "You learn how to build things and to calculate."

We follow up. "Is there anything you could do to make it an even better learning game?" we ask. We are planning to run a second competition wherein kids themselves, kids just a few years older than her, can design special learning levels for LBP. We'll be giving awards for the very best ones. Experienced users being able to customize the game by creating new levels is a reason it's won the Interactive Achievement Award for Overall Game of the Year, equivalent to an Oscar for Best Motion Picture, from the Academy of Interactive Arts and Sciences (AIAS).

"You could give Sackboy different *personalities*," the other girl says, another head-turning word. "One Sackboy could be a nerd, one could be smart, one could be silly, and then you'd have to play the game different depending on his personality . . ." Her voice trails off. She can't quite complete the thought, but I'm blown away.

They are learning a lot in school, even with all the rules; I can't forget that. Those teachers are struggling against odds of poverty, a mediocre facility, low pay, and, unbearably, the "lockdown" of being declared a "failing school" because its test scores don't measure up to the average set by No Child Left Behind. Not even Sackperson could rise to that challenge without some serious discipline and direction.

No wonder there were warning signs on the kindergarten door! "Be Prepared All Ye Who Enter Through This Portal!" They will be drilled. And drills—unlike *challenges*—never feel like fun. The kids have absorbed that lesson. If school drills are what constitutes learning, LBP isn't learning. Except that when you test the kids, as we did, asking them pointedly about their two days of big fun, you find that, lo and behold, they not only learned and had a great time, but they can answer with concepts like "structure" and "personality." If we were running our office on standards-based public school principles, we could have started with questions like that—teaching to the test, it's

called—and, if we had worked hard enough at it, probably could have ruined a perfectly great snow day.

I ask my friend David if we can go to a school that he thinks exemplifies the best in public education, and he takes me to Forest View Elementary. It has the same demographic as the other school, the same racial and economic mix of kids. It's not a magnet school but a neighborhood school, with 60 percent free or reduced lunches. The school building itself is lovely, a much newer school than Middleton. And there are special touches everywhere. Many, I find out, are exactly what the principal at Middleton mentioned, those small "extras" that public schools don't have the budget for and that make a big difference. These happen to come from the Duke-Durham partnership program—recycled computers, old textbooks and children's books, supplies in the abundant art room, fossils and other cool things in the science rooms, even bright used tennis balls on the feet of the chairs, to ensure silence and unscuffed floors. David often comes over with sacks of them. I happen to run into one of my own students in the hall. He's talked to me before about his cousin who is autistic, and he says he's at Forest View as a volunteer, helping a teacher in a special-needs class.

We're there today to talk to the teachers about kids who might be eligible for a special science program called Boost, wherein kids in fifth grade will be doing actual research with graduate and medical school students and faculty at Duke, beginning in summer and continuing in the school year. Teachers have selected candidates, who have spent a pizza lunch with David, working in teams to solve problems David has set them, and have filled out an application with their parents. All this is being weighed again, in conversation with two science teachers eager to have their best and most deserving kids in this very special program. There are about five times more candidates than there are places.

Forest View is not a failing school, and I can feel the spirit here before I've even set foot inside. Not only is there art, and gardens, and garden art, and playgrounds, and color and brightness, but the warmth just flies at you from the second you step inside. Kids are joking in the hall, not walking in rows with their hands behind their backs. They seem to work in a lot of groups, not in rows, and so much is happening everywhere that I barely know where to look.

So we start at the beginning, in another kindergarten class.

When we enter, teacher Sarah Tichnor is finishing reading a story. She's sitting on a stool and the kids are on the floor, watching as she reads. They are

in a little reading alcove carved out of the cavernous room, books on all sides, like a cozy little cave. The larger room is alive with life and spaces and animals and computers and interesting things, great stuff to look at and do things with. In this reading corner, there's a long row just of books, all kinds of books, many of them used and donated to the school.

"That's it for today," Ms. Tichnor says and the kids get up and go immediately for their mats.

"Oh, it's nap time!" David says cheerfully,

Suddenly eighteen pairs of eyes swing in our direction, bottom lips jutted out, and one little girl even puts her hands on her hips. Before we can react, the teacher has stood up, tall, and said to us, in that corrective and pedagogical tone usually reserved for preschoolers, "On no! This is a *kindergarten*. In kindergarten, we don't take naps. We're getting ready for silent reading."

The kids turn their backs on us and go look, seriously, at the bookshelf. Each child selects a book. Then, mat in hand, they each begin to spread out far from one another, all over the large room. The teacher has not said a word to them about no hitting, no talking, no punching, no joking.

"They spread out," she says to us in that same authoritative voice, "so that no one can distract them from their hour of silent reading."

The eighteen heads nod up and down definitively.

These are the luckiest children on earth, to be big enough to have a whole hour to do what big kids—kindergartners—do: read silently to themselves.

The independence, the maturity, the pride in learning are conveyed without a single negative. The individual kids place themselves far enough apart so *they* won't be distracted.

I'm very impressed. This teacher is setting up these kids for new challenges ahead, for independence, for new levels of learning, new pride not only in what they were learning but in how learning changed them as people. Silent reading isn't the punishment; it's the reward. Learning is for big kids. Who would want to be distracted from learning?

That's pretty much what I aspire to as an educator: not in teaching facts but in conveying to my students the passion of learning, far beyond my classroom, far beyond any graduation ceremony.

Those kids were coming from very modest, even impoverished, backgrounds and were at a neighborhood school. No worries. They were on fire with learning.

"*This is kindergarten*"—and all the world of future wonders that entails.



These lessons in setting up a classroom came back to me when it came time for me to return to teaching after several years in my R & D job as a university administrator. Now suddenly I found myself with a chance to put into practice all of the ideas that had been percolating in my mind about what it takes to design a class for the way we live now. I was determined to remember the lessons of intellectual respect and independence we'd learned from the iPod experiment. In a world of helicopter parents, hovering overhead, and boomerang kids, returning to the family basement because they can't find a job after college, those lessons are hard-won. The age and context were different, but I wanted my students, too, to swell with pride in their own accomplishment: "*This is a university.*"

I decided to offer a brand-new course called *This Is Your Brain on the Internet*, a title that pays homage to Daniel Levitin's delightful and inspiring book *This Is Your Brain on Music*, a kind of music-lover's guide to the brain.²⁵ Levitin argues that music makes complex circuits throughout the brain, requires all the different kinds of brain function for listening, processing, and producing in various forms, and makes us think differently. Substitute the word *Internet* for *music* and you've got the gist of my course.

Because no one knew me in the classroom anymore and there was no word of mouth about the kind of teacher I was, I advertised the class widely. In what department, exactly, does *This Is Your Brain on the Internet* belong? Its main home was ISIS, our new program that brought together the computational sciences, the social and human analysis of the role of technology in society, and multimedia arts. I advertised everywhere else too, and I was delighted to look over the class roster of the eighteen students in the seminar and find more than eighteen majors, minors, and certificates represented. Score!

Next, I took on the syllabus. I created a bare-bones suggested reading list that included everything from articles in specialized journals such as *Cognition* or *Developmental Neuropsychology* to pieces in popular magazines like *Wired* or *Science* to novels and memoirs. There were lots of Web sites too, of course, but I left the rest loose. This class was structured to be peer-led, with student interest and student research driving the design. "Participatory learning" is one term used to describe how we can learn together from one another's skills, contributing to a collective project together. "Cognitive surplus" is another term used in

the digital world for that "more than the sum of the parts" form of collaborative, customized thinking that happens when groups think together online.²⁶

We used a method that I call "collaboration by difference" that I had pioneered while vice provost and that has become the primary principle of HAS-TAC, the network dedicated to new forms of learning for a digital age that I cofounded with Professor David Theo Goldberg and other educators in 2002. Collaboration by difference is an antidote to attention blindness. It signifies that the complex and interconnected problems of our time cannot be solved by anyone alone and that those who *think* they can act in an entirely focused, solitary fashion are undoubtedly missing the main point that is right there in front of them, thumping its chest and staring them in the face. Collaboration by difference respects and rewards different forms and levels of expertise, perspective, culture, age, ability, and insight, treating difference not as a deficit but as a point of distinction. It always seems more cumbersome in the short-run to seek out divergent and even quirky opinions, but it turns out to be efficient in the end and necessary for success if one seeks an outcome that is unexpected and sustainable. That's what I was aiming for in *This Is Your Brain on the Internet*.

In addition to a normal research paper, I had the students each contribute a new entry or amend an existing entry on Wikipedia, or find another public forum where they could contribute to public discourse. There was still a lot of criticism about the lack of peer review in Wikipedia entries, and some profs were "banning" Wikipedia use in the classroom. I don't understand this. Wikipedia is an educator's fantasy, all the world's knowledge shared voluntarily and for free in a format theoretically available to all for free, and that anyone can edit. No rational-choice economic theory of human nature or human motivation explains the existence of Wikipedia! Instead of banning it, I challenged my students to use their knowledge to make Wikipedia better. All conceded it had turned out to be much harder to get their work to "stick" on Wikipedia than it was to write a traditional term paper.

SPEAKING OF TERM PAPERS, LET'S stop for a moment to talk about student writing, an essential component of any academic program. It isn't as easy to make a judgment about a student from her papers as it might first appear. Given that I was teaching a class based on learning and the Internet, having my students blog was a no-brainer. I supplemented this with more traditionally structured academic writing, and when I had both samples in front of me, I discovered

something curious. Their writing online, at least in their blogs, was incomparably better than in the traditional term papers they wrote for the class. In fact, given all the tripe one hears from pundits about how the Internet dumbs our kids down, I was shocked that elegant bloggers often turned out to be the clunkiest and most pretentious of research paper writers. Term papers rolled in that were shot through with jargon, stilted diction, poor word choice, rambling thoughts, and even pretentious grammatical errors (such as the ungrammatical but proper-sounding use of *I* instead of *me* as an object of a preposition).

But it got me thinking: What if bad writing is a product of the form of writing required in school—the term paper—and not necessarily intrinsic to a student's natural writing style or thought process? I hadn't thought of that until I read their lengthy, weekly blogs and saw the difference in quality. If students are trying to figure out what kind of writing we want in order to get a good grade, communication is a secondary point of the writing. What if "research paper" is a category that invites, even requires, linguistic and syntactic gobbledegook?

Research indicates that, at every age level, people take their writing more seriously when it will be evaluated by peers than when it is to be judged by teachers. Online blogs directed at peers exhibit fewer typographical and factual errors, less plagiarism, and generally better, more elegant, and persuasive prose than classroom assignments by the same writers. A longitudinal study of student writers conducted at Stanford by Angela Lunsford, a distinguished professor of rhetoric, used the same metric to evaluate the quality of writing of entering Stanford students year after year. Lunsford surprised everyone with her findings that students were becoming more literate, rhetorically dexterous, and fluent—not less, as many feared.²⁷ Using the same evaluative criteria year after year, she could not prove any deleterious effects on the writing of the exceptionally gifted students at Stanford from exposure to the Internet. Pundits insist even elite students are being dumbed down by their writing and reading online, by their texting and Tweeting and their indulgence in other corruptions of standard English. Looking at the data, Lunsford found no hard evidence of decline among Stanford students. She found no empirical basis for hand-wringing or jeremiads about the digital generation going to the dogs.

My students were surprised to read these studies. As lifelong A students, they believed what their teachers had told them about the canine-like intellectual nadir their generation had achieved. Yet when I pushed a little more, they also readily admitted that they had many hang-ups about research papers. Many

came to university with such a trove of past negative experiences around term papers that, they admitted, they often procrastinated until the last moment, then forced something to come together. We also talked about the matter of practice. A student typically writes research papers only in school, one per term, at an average (this is another study) of forty-two pages of papers for each semester's classes. During the same period, the average college student writes five hundred pages of e-mail.²⁸ That's a lot of practice at prose, even if they are not writing the finished product as in a formal essay. If this were golf or tennis, and they were warming up on the putting green or by hitting balls against a wall before a tournament, we'd expect improved results. Give the amount of time youth spend writing online, it's not all that surprising that their blogs were better, when judged by the most traditional English teacher standards, than their research papers.

But students weren't expecting that result. They all came into class assuming that I and other educational professionals would believe the Internet was "bad for you," whatever that means. In fact, they all downplayed their online proficiency at first, considering it (and especially gaming) as a sign that they weren't "smart." One student confessed only belatedly that he had attained the highest level in WoW (World of Warcraft). He came clean only after another student, a professionally trained modern dancer, stood up in class to illustrate to us the difference between a verbal and a kinetic description of movement. Another demonstrated how he won quite a lot of money by playing online poker, using a stunning background in both statistics and psychology to succeed. Only then did our Level 80 Warlock admit his own accomplishments.

The semester flew by, and we went wherever it took us. The objective of the course was to get rid of a lot of the truisms about "the dumbest generation" and actually look at how new theories of the brain and of attention might help us understand how forms of thinking and collaborating online maximize brain activity.

We spent a good deal of time thinking about how accident, disruption, distraction, and difference increase the motivation to learn and to solve problems, both individually and collectively. To find examples, we spent time with a dance ensemble rehearsing a new piece, a jazz band improvising together, and teams of surgeons and computer programmers performing robotic surgery—a choreography as careful and as improvised as that of the artists. We walked inside a monkey's brain in a virtual-reality cave. In another virtual-reality environment

at the University of North Carolina, we found ourselves trembling, unable to step off what we knew was a two-inch drop, because it looked as if we were on a ledge over a deep canyon. A few students were able to step over the edge, but I could not. We were all fascinated to learn the body-gripping illusion doesn't work, though, unless you lead up to it by walking up a very slight incline that tells your brain you're climbing, yet another testimony to the fact that while we think we know the world, we really only know the world our body thinks.

One of our readings was *On Intelligence*, a unified theory of the brain advanced by Jeff Hawkins, the neuroscientist who invented the PalmPilot. I agree with many of Hawkins's ideas about the brain's "memory-prediction framework." My own interest is in how memories—reinforced behaviors from the past—predict future learning, and in how we can intentionally disrupt that pattern to spark innovation and creativity. Hawkins is interested in how we can use the pattern to create next-generation artificial intelligence that will enhance the performance, and profitability, of computerized gadgets like the PalmPilot. He believes we need to redesign artificial attention by pattern prediction, not by specific tasks.²⁹ The students and I were having a heated debate about his theories in class when a student discovered that Hawkins happened to be in our area to give a lecture. Mike, who was leading the sessions on Hawkins, attended the lecture, told Hawkins about the debate, and invited him to our class. I was in Chicago at a MacArthur Foundation meeting on the day of Hawkins's lecture, when suddenly my BlackBerry was vibrating with e-mails and IMs from my students, who had convened the class without me to host a special guest on a special topic: Jeff Hawkins himself debating the ideas of Jeff Hawkins. It felt a bit like the gag in the classic Woody Allen movie *Annie Hall* when someone in the line to purchase movie tickets is expounding pompously on the ideas of Marshall McLuhan and then McLuhan himself steps into the conversation to settle the matter.

It was that kind of class. This Is Your Brain on the Internet didn't look or feel like any course I'd ever taught before. It had no standard field, discipline, topic, syllabus, method, or conclusion, and, for that matter, no standard teacher either. The semester ended not with a body of knowledge mastered but with a certain skepticism about easy answers to questions like, Is multitasking good for us? or even, What is multitasking? My students became adept at taking *any* statement of fact and asking, What does that really mean? What are the intellectual blind spots of this study? What is not being taken into account because,

in this framework, our attention blindness won't let us see it? When is it a two-inch ledge and not a canyon?

Nothing in my own traditional training had prepared me for this way of knowing what we don't know. There were times when I was nervous that I might not be leading them in the right direction. But each time I wavered, their confidence reassured me that we were on to a new way of paying attention, a new way of learning in a digital age. As with Mrs. Davidson, as with Katie Salen, this class connected to the real world; it was about testing assumptions, not accepting them; it was about collaboration and debate; and perhaps most of all, it was about gaining the confidence to feel that, however you are tested in the future, you can count on your capacity to learn and succeed.

Many students said it was the best class they'd had in four years of college. But it wasn't just a class. It was a different way of seeing. We'd seen a transformation not just in the classroom but in all of us.

"Jeff Hawkins thought it was odd that we decided to hold class when you weren't there," one student texted me. "Why wouldn't we? That's how it works in *This Is Your Brain on the Internet*."

Project Classroom Makeover. I heard the pride. Step aside, Prof Davidson: This is a *university*!