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Rethinking Education in a Technological World

We argue for a new vision of education. To be successful, political and educational leaders will need to carefully consider the changes in our society and mobilize the government's resources to address the problems we've raised and to achieve the great potential ahead of us.

Since the end of World War II, the United States has enjoyed a disproportionate share of global resources. This abundance allowed Americans to maintain a high standard of living and take a world leadership role. Thomas Friedman's "the world is flat" argument suggests that access to information technologies has leveled the global playing field.[1] This leveling is allowing millions of engineers, technologists, and professionals from around the world to pursue the careers that have made so many Americans wealthy. The future prosperity of countries around the world depends on how their education systems can be designed to foster economic development. If the United States is going to compete successfully in a global economy, it will have to rethink many of its assumptions about education.

The formula for economic success has a high cost. As has happened in the United States, countries that focus on knowledge economies as the source of wealth generation tend to concentrate economic resources on an elite class. The gap between the haves and have nots is growing, not shrinking, in many developed countries, and focusing the national commitment in education toward elite populations motivated to participate in math, science, and technology careers might further widen the gap. Global competition might spark what W. E. B. DuBois called a "top 10%" education strategy that will concentrate resources and push the most talented students toward globally competitive professions. Writers such as Gary Orfield and Chungmei Lee suggest that resegregation of schools and communi-

ties, voucher policies, and charter schools are already pushing our education policy away from its commitment to equity.[2]

Just how technological developments will help us balance the goals of equity and global competition is not yet clear. The rethinking of education that we promote with this book should aim toward strategies that provide access to the new educational resources for everyone in society, and give people the motivation to take advantage of these resources. This demands rethinking education not in isolation, but considering the interplay of society, education, and learning.

RETHINKING LEARNING

We grew up with the idea that learning means taking courses in school. As we argued throughout this book, the identification of education with schooling is slowly unraveling, as new technologies move learning outside of school's walls. In some sense, the divorce of schooling and learning may take us back to an era where individuals negotiate their own learning experiences, often with strong guidance from their parents.

Eventually, when people and politicians become worried about what kids are learning or what adults don't know, their automatic reaction may not be "How can we improve the schools?". Instead, they may ask, "How can we develop games to teach history?", "How can we make new technology resources available to more people?", or "What kinds of tools can support people to seek out information on their own?". Currently, the strong association between schooling and learning forces our conversation into institutional responses. We don't yet know how to ask these wider questions when we think about improving education. We hope this book starts that conversation.

As learning moves out of school, our conception of learning will begin to broaden, and we will see more hybrid experiences that begin in the classroom and move into other contexts. Education may follow the path of home schooling by emphasizing field trips, interacting with peers, playing computer games, or even teaching others with technological tools. For example, a teacher who taught computer programming was approached by a few of his students who wanted to bring their own computers into the school and hook them up in a network to engage in multiplayer games with one another. They asked to form a computer club where they would begin to develop computer games of their own. As new kids joined the club, the

first group would teach them some of the things they themselves had learned. Later, when the teacher was given the task of setting up a network in a nearby school, the kids helped him with the design and implementation of the network, and with getting students in the other school working with their new network. Although all this learning took place in a school setting, it was not "real school" learning. Technology directors around the country are experimenting with similar models that rely on students to provide network design and support.

Our vision of education in this book is structured around the idea of *lifelong learning*. Lifelong learning requires moving away from highly structured schooling institutions to instead act as consumers of a wide variety of learning experiences. Learners will need to develop the skills to judge the quality of learning venues and the kinds of social networks that provide guidance and advice.

Brigid Barron provides a good example of how students learn to become intelligent consumers of learning environments through developing their computer skills.[3] For example, one middle school girl in California named Stephanie, who was the daughter of Chinese immigrants, had a group of friends who used GeoCities to create their own web pages. They taught Stephanie how to use HTML, which appealed to her since she liked to draw. Then, in seventh grade, she took courses in programming, web design, and industrial technology, where she used a computer to do designs. In eighth grade, she decided to develop a web page for her family and helped her father design a web page for his new business. She even taught her mother different ways to use computers. As she got further into art with the computer, she lurked in the background of Xanga, an online digital-art community, trying to pick up techniques for making computer art. She would study the finished works and the source code that the artists used to produce their works. She is a typical self-directed learner in the digital age.

The recent explosion of social networking points to how technologies can replicate the support and guidance functions of schools. These networks draw people across all ages from very different backgrounds, some quite expert and others virtual novices. Some learn by lurking in the background and others by asking questions. Groups in the network may jointly investigate topics of interest or argue about issues they consider important. The successful sites, however, share the characteristic of providing useful information to guide the interests of users. For example, user groups and community sites exist for every known disease and disorder, and doctors across

the country know their diagnoses are checked by an increasingly informed patient population. These kinds of social networks are blossoming around topics of particular interest to different groups of people, topics such as poetry, chemistry, digital graphics, and fantasy sports. Reliable information sites, such as homework.com, tutor.com, and collegeboard.com, are already supplanting the guidance departments, financial aid centers, and even the tutoring and homework services that are provided as common staples of institutional schooling.

What might happen if our thinking about learning doesn't change? If schools cannot change fast enough to keep pace with advances in learning technologies, learning will leave schooling behind. We see this happening outside of the United States already. For example, with inexpensive computers, young people in Thailand and Brazil can have access to the same resources for learning that people in the developed world now have. Many will choose to take advantage of these resources to escape from poverty. In some ways, they will be a new kind of 21st-century immigrant—instead of moving to a new country, they will use information networks to transform their thinking. They will be able to find like-minded souls to share ideas in cyberspace. English will likely be their common language, which they will pick up from the web.

As older generations continue to impose established methods of learning in school, technologies will leech critical learning resources, such as student motivation, attention, and resources, out of the education system. Trying to reassert the identification of schooling and learning will be a losing battle.

RETHINKING MOTIVATION

The current school system does not help students develop intrinsic motivation to learn. The disengagement experienced by many students is reinforced by less-than-ideal classroom experiences. One recent report found that 50% of high school students are bored every day in their classes; another found that 82% of California 9th- and 10th-graders reported their school experiences as "boring and irrelevant."[4] Changing these deeply ingrained attitudes about learning will mean changing both the process of teaching and learning and the reward system for successful completion of schooling.

Fortunately, learning technologies provide some direction about how to improve student motivation to learn and to invigorate learning content.

In order to produce a generation of people who seek out learning, learners need to be given more control over their own learning. Learner control can be fostered by giving kids the tools to support their own learning, such as access to the web, machines for toddlers that teach reading, tutoring help when needed, and computer-based games that foster deep knowledge and entrepreneurial skills.

A love of learning can also be fostered by encouraging kids to explore deeply topics in which they are particularly interested, as home-schooling parents do. As Kurt Squire found, kids who play real-time strategy games, such as *Civilization*, begin to check out books on ancient cultures and earn better grades in middle school.[5] Instead of diverting student attention from schools, as feared by many teachers and school leaders, video games can provide a path to make conventional school content more appealing and encourage students to give their classroom instruction another chance. By understanding how new technologies can encourage kids to take responsibility for their own learning, society may help produce a generation of people who seek out ways to learn.

Pushing students to take more control of their learning, as we have discussed, runs counter to the institutional control of learning exercised by schools. Fostering self-learning will require challenging the current policy assumptions that press schools to teach everyone the same thing at the same time. Even the one-room schools that preceded universal schooling resisted this contemporary impulse to standardize instruction. Integrating computers into the center of schooling, rather than at the periphery, could help learners pursue individualized, interactive lessons with adequate support. Such systems can control the level of challenge by choosing tasks that reflect the learner's recent history. Teachers can help out when students need more assistance than the computer can provide. Such individualized learning would remove the stigma of looking bad when you don't understand something that others grasp.

Technologies also point to another path toward fostering a love of learning through design and production. Savvy computer game developers have long realized how including design tools to alter the game environment greatly increases the replay value and brand loyalty of their games. Giving students meaningful tasks to accomplish will help them understand why they are doing what they are doing. Students who struggle in school spend hundreds of hours tweaking football rosters to meet salary cap requirements in *Madden* or editing parody videos on YouTube. Suddenly, when the drudge work of complicated tasks becomes contextualized and

has new significance, students are more than willing to take the time to "get it right." As a society, we need to understand how new technologies turn kids and adults on to learning, in order to redesign our learning environments to provide positive motivational experiences for all learners.

RETHINKING WHAT IS IMPORTANT TO LEARN

Of course, providing intrinsic motivation to learn also requires us to rethink the rewards of successfully completing a course of learning. There is a mismatch between the programs that schools offer and the kinds of skills that are needed to live a successful life in a knowledge economy. The core curriculum in modern schools is still rooted in the medieval *trivium* (from which the word *trivial* is derived), which consisted of logic, grammar, and rhetoric, and *quadrivium*, which was made up of arithmetic, geometry, music, and astronomy. These formed the bases for the liberal arts, which dominate the current course of study in school and college. Over the centuries, we added courses such as history, geography, and the sciences, but the basic organization of the curriculum reflects its historical roots.

A question that society must wrestle with is whether this is the best curriculum for preparing students to live in an age with rich technological resources. Proponents of traditional curricula argue that classical training in thinking and writing is needed now more than ever; progressive educators suggest that new literacy skills and mathematical reasoning skills are needed for new times. In schools, however, the compromise between the two camps is often to organize content roughly in classical disciplines, but to remove the rigor and the context from the classical content. Thus, geometry is presented without a sense of history, and sciences are learned as sets of facts instead of methods to organize observations and experiments. Because we think of education as what goes on in school, this compromise curriculum furnishes a narrow and quite impoverished view of what is important to learn.

There are two areas in which the new technological resources clearly impact what is important to learn: communication and mathematics. In 21st-century communication practices, boundaries are becoming blurred between core literacy practices, such as learning to read and write, and more applied production and presentation practices. Creating multimedia documents, putting together and critiquing videos, finding information and

resources on the web, and understanding images and graphics are all becoming important aspects of communication. New technologies offer interesting ways to make the transition between basic and applied literacies. For example, the people who play massively multiplayer online games (MMOGs), such as *World of Warcraft* or *Lineage*, use basic literacy practices to develop a whole range of other applied literacy skills, such as negotiation, bargaining, forming alliances, strategizing and outwitting opponents, calculating which approach is most likely to work, and communicating with different kinds of people. These applied literacy skills occur naturally in MMOGs but are difficult to maintain in traditional school environments. Yet, because we think of literacy skill development as being directly tied to traditional school content, most people regard gamers as wasting their time playing these multiplayer games.

In terms of mathematics, technology can carry out all of the algorithms that students spend so much time learning in school. At the same time, learning to think mathematically is more important than ever. Therefore, students' time might be better spent in learning how to use mathematical tools to solve real-world problems, rather than learning how to mimic computer algorithms. In fact, understanding how to apply computer tools appropriately requires much more thinking than executing algorithms. It should become the new agenda for teaching mathematics. Fantasy sports present a case in point for teaching applied mathematical skills. Calculating on-base percentages or adding up runs scored may not involve sophisticated algorithmic processes, but even the most casual fantasy baseball player must engage in predictive models to anticipate which players and teams have the best chance to succeed. Having fantasy players articulate their predictive models is an excellent exercise in developing the kinds of estimation and number sense skills prized by organizations such as the National Council of Teachers of Mathematics.

A subtle impact of technology on learning has to do with the easy availability of knowledge on the web. In the past, people have had to memorize a lot of information in order to make competent decisions, as doctors must do to make accurate diagnoses. But with easy access to knowledge, people can rely more on external memories to help them out. We can illustrate this phenomenon with the use of technology by doctors. Online systems have been developed in recent years that help doctors make diagnoses. Doctors can feed the systems with sets of symptoms, and the systems can suggest possible diagnoses that the doctors should consider. That way, the doctor does not have to remember every possible pairing of symptoms to

diagnoses. Doctors still must apply their personal knowledge, gained from experience and from interaction with the patient, in order to make their decisions. These systems act essentially as memory aids. Similarly, the web is a huge memory aid, in addition to providing new information on every topic under the sun. The essential skill is no longer memorization, but knowing how to find the information you want on the web, including how to evaluate what you find, given the differences in reliability among web sites. That is to say, people need to develop new learning skills rather than acquiring more information.

One approach to a new specification of what students need to know is provided by a Harlem high school.[6] The school stresses that the students should learn to ask and answer reflective questions that correspond to five Habits of Mind: 1) From what viewpoint are we seeing, reading, or hearing this?; 2) How do we know what we know? What's the evidence, and how reliable is it?; 3) How are things, events, or people connected? What is the cause and effect? How do they fit?; 4) What if . . .? Could things be otherwise? What are or were the alternatives?; 5) So what? Why does it matter? What does it all mean? Who cares? These questions are central to everything the students do in the school, and even in the evaluation of students to determine if they have learned enough to graduate. These questions stretch the definition of what is taught in a school to encompass the types of thinking and action required for adaptive thinking in an information-rich world.

RETHINKING CAREERS

While education has traditionally aimed to enlighten learners about their political responsibilities, American discussions of education have recently turned sharply toward career preparation for economic success. But as routine jobs are replaced by technology or shipped offshore, the remaining jobs emphasize collaboration, communication, and knowledge-processing skills. From an economic perspective, it's imperative for education to focus much more on teaching students how to think critically in a digital age, and how to find the knowledge and resources they need to accomplish difficult tasks. Students would be much better served if they were challenged to solve real-world problems and create meaningful products. Then they might have some incentive to learn how to think.

Career mobility also challenges educational institutions to teach students to become more adaptive. The traditional American story was that

we went to school to prepare ourselves for a career, whether as an auto mechanic or a doctor. We would settle on a career sometime during high school or college and take courses geared toward success in that career. In the 1980s and 1990s, however, the erosion of corporate responsibility for lifetime employment sparked increased job mobility across the economy. Currently, 50 to 60% of new hires leave their jobs within the first year, and 10% of the workforce leaves their jobs every year.[7] As we live longer, it turns out that many of us may be working into our 70s and 80s. Most Americans in the next 20 years will likely have a succession of careers.

As an example, one of the authors started his career as an auditor on Wall Street after getting a college degree in accounting. After a few years as an auditor, he returned to graduate school in computer science and 10 years later graduated with a Ph.D. in cognitive psychology. After that, he went to work in a firm that carried out research for the federal government in a variety of areas, most related to the use of computers in society. In his research work, he slowly moved from carrying out psychological research to developing computer systems for education. After some 20 years in research, he joined the education faculty at Northwestern, never having taken an education course during his career. Then, for 18 more years, he taught a variety of education courses at Northwestern. The second author started out as a graduate student in philosophy. He took a job as a history teacher in a small Chicago school. After several years of teaching, he became an administrator at the school. Later, he decided to return to graduate school in education. After 5 more years in graduate school, he became a professor at a large graduate school of education. It remains to be seen what he will do next. These stories, although they focus on academic careers, are not unusual. Such twists and turns in careers are becoming more and more common. The fate of people in a knowledge society, it seems, is that they must keep reinventing themselves in order to keep up with the changing world around them.

Eventually, people will come to think of life as made up of a succession of careers. In order to cope with this idea, they will begin to see how important it is to "learn how to learn." They may come to see that the career they decide to pursue in their early years is not a commitment for life. As Avner Avituv and Robert Lerman point out, "Every month, millions of workers leave one employer and take a job with another employer. It takes young workers a long time to enter a stable career and a long-term relationship with an employer. By the age of 30, high school graduates with no college have already worked for an average of eight employers. Nearly

half of all male high school graduates experienced at least one spell of unemployment between ages 25–29. Moreover, job instability is increasing among young men."[8]

In recent years, there has been a growing gap between the incomes of college graduates and high school graduates. This has led over 90% of high school students to plan to go to college. But only 14% of kids with a C average in high school will complete a college degree.[9] They would be better off working for a few years after they finish high school and then going back to get more education. The success in college of returning veterans after World War II testifies to the payoff in waiting to go to college. A study by Norman Frederiksen found that the veterans had higher achievement levels than non-veterans.[10] Some of the pressure to go right on to college will be relieved if people come to understand that their life in the future will likely alternate between working and learning. It will no longer be 15 or 20 years of preparation followed by 30 years of working. Rather, we will learn for a while, work for a while, back and forth, until we retire.

Of course, some people in the future may be actors or auto mechanics for all of their lives. But they will be the exceptions. Thinking of a single career as the standard pattern leads people to think that they are done with learning when they finish school. So they do not keep their minds open and focused on continuing their learning. This makes them less adaptable when they are hit with the necessity of changing careers. Parents also need to understand how the nature of people's careers has changed, and not try to force young people to prepare for a particular career that they think is best for them. As a society, we need to build policies that support people in making the many career transitions they will have to make in a constantly changing environment.

RETHINKING THE TRANSITIONS BETWEEN LEARNING AND WORK

America has not helped its citizens manage the transition to adulthood as well as other countries with apprenticeship systems. Both high school graduates who don't enter college and students who drop out of college early have entered the workforce unprepared. Since only about 30% of students in America ever get a college degree, the vast majority of students have a more difficult transition to make. Typically, they drift from job to

job until they are 25 or 30. Some return to college when they are older, but it is often harder for these students because society does not support older people returning to college. Given the increasing centrality of technology in work and the fact that people are more and more likely to change careers several times during their lifetime, it is worth rethinking the ways that society supports the transitions between learning and work.

The transition to work is handled fairly well when people graduate from college. The colleges maintain an office designed to help students find jobs, both as interns during college and when they graduate. This office has extensive files on employers in their area and many have files on alumni employed in different occupations who can guide students in choosing a career. Different employers come to colleges to recruit graduating students who are interested in working for them. Often, college students intern for different employers during the summers or during one of their later semesters, building ties with potential employers after they graduate. And college professors often write letters of recommendation for their students, even pointing them to potential employers. High school career centers and teachers sometimes perform this function, but it is sporadic and concentrated in wealthier communities. So there is an effective system in place, but only for college graduates.

In an era of multiple careers, people will need support to navigate their options, both in going from learning to work and from work to learning. If America wants to remain a successful society, it needs to create new ways to support citizens through these challenging transitions.

We believe America must transform how we address technical and vocational education. For example, schools should reconsider how to support teenagers who want to go into the job market, either in addition to or instead of going to high school. Teenagers should not go to work until they have mastered the basic skills and knowledge taught in middle school. Hence, there needs to be an office in high schools that determines whether teenagers have met the standards for going to work and that helps them find jobs that are well suited to their goals and abilities. This office would keep files of possible jobs, just as college employment offices do. It would help students put together resumes and assess their interests and abilities. It would also help gather teacher recommendations and make initial contacts with employers. In short, the office would carry out many of the same functions as college employment offices, but would provide more guidance, since the students are younger. Modest federal funding in this area

would provide significant value in helping students make a successful transition between learning and work.

The same office might administer apprenticeship programs, such as are widely found in Europe.[11] In these programs, adolescent students typically work 3 days a week and go to school for 2 days a week. The programs attempt to coordinate what students are learning in school with the work for which they are training. Given the aimlessness of much work that teenagers are now doing, society would be well advised to put federal money into supporting a robust apprenticeship system. The office might also support students who have gone to work and wish to return to full- or part-time learning. The office could advise them about their options, such as taking high school or community college classes, online courses, or courses administered by a local learning center.

Such offices can also serve adults, who need help in thinking about embarking on a new career or returning to get more education. These counseling offices might be maintained by the state in all high schools, or they might be privately run. They would have counselors who can advise people on the kind of training and credentials they need to pursue a particular career, and what kind of educational resources are available to pursue that training. Other counselors could assess the skills and interests of adults to guide them toward viable careers they might pursue. Still other counselors would have knowledge and contacts with employers in the region, and could help people find jobs that suit them, given their educational background. These are resources we need to be providing to people to make our society as productive as possible.

Our view is that the government should pay for these learning resources, at least up to the level of what would be spent on a high school education. School-to-work programs, such as the School-to-Work Opportunities Act of 1994, provide a good start toward institutionalizing these types of services. Unfortunately, in recent years, these modest initiatives have been gutted by budget cuts. In 2006 alone, the Bush administration proposed to cut $1.1 billion in state vocational education grants. Cutting these transitional services means that the students with the least social capital, who need the most help connecting to viable economic resources, are left to make their own connections. There are so many alternatives that it is bewildering for most people, so they need counseling to make wise decisions. We will all profit from others learning all they can and finding employment that suits them.

RETHINKING EDUCATIONAL LEADERSHIP

We are experiencing a time of educational transition, which demands a new kind of educational leadership—a new Horace Mann, as it were. We need a vision of education that makes it possible for the new array of educational resources to reach all of the people. The trends in place are reaching the elites, and leaving behind the vast majority of people. The next generation of education leaders will need to face the political and technological challenges. The challenges of changing a well-established, entrenched institution are far different than those faced by Horace Mann. Parents, teachers, policymakers, and local communities all have compelling reasons to preserve the current system. The forces for change, such as the civil rights emphasis on using schools to increase social equity and the technological emphasis to open the core practices of schooling to information technologies, push uncomfortably against influential conservative forces. Leaders who can effect real change need to understand where the leverage points are to move the system, and need to have the organizational skills to bring together the resources and skills necessary to create change.

One possibility is to promote the inexpensive computer as a tool that can put powerful computing in the hands of all students. Such machines provide access to a vast array of educational resources for nonelites. Programs such as One Laptop Per Child[12] are currently aimed only at Third World nations, though they could be expanded to address poor people wherever they live. But we need to think much more broadly to address the inequities that are arising. Simply inserting technology into classrooms and schools without considering how the contexts for learning need to change will likely fail. Schools are still hesitant to embrace new technologies as a backlash from the significant, and largely ineffectual, investment in classroom computers as an instructional panacea in the mid-1990s.[13] Leaders need to understand the limits of the new technologies in order to set appropriate expectations for their communities. They will need to think about how to bring coherence to the incoherent array of tools already in schools and in the world.

In the future, educational leadership will require more than just reforming schools. We need to think about how to integrate nonschool resources into learning environments, both supporting families in bringing these tools into their homes and in building wired learning centers in communities that reach those in need. We need to support robust language-rich resources, which very young kids can use to learn to read. We have

such programs for computers now, where, for example, a kid can hear a Dr. Seuss story by pointing at the words or lines on the screen to have them read aloud. As the kids learn the sight-to-sound correspondences, they will pick up reading of their favorite stories on their own. These machines should include the best children's literature, covering a wide variety of genres and topics. They should also include arithmetic games that would teach basic mathematical operations to young kids. Every young kid should have such a machine, since busy parents often do not have the time to read with their children. It might begin to address the inequity that many kids face.

Elementary school should provide an array of technology-based supplementary services to help students who are having trouble. Such services are envisioned by the No Child Left Behind (NCLB) Act as extending current special education and student services programs. If a child is having difficulties in one of his school subjects—say writing, math, or geography—then the first course of action should be to provide the child with a customized diagnostic process that connects the student's learning needs with appropriate resources. Technologies can provide a wide variety of resources, such as computer-based learning programs or access to online tutoring. Technologies allow students to use programs at home with their families as well as at school. If the programs do not succeed completely, then the kids might be provided with specialized human tutoring, as NCLB envisions. But human tutoring is a costly option that may not be necessary in most cases.

After eighth grade, kids might follow different educational paths, depending on their own and their parents' choosing. For example, as an alternative to continuing on to a traditional high school, a student might take online courses at home or in a learning center, enter an apprenticeship program, take courses at a community college, or attend a Career Academy, like we see in cities such as Oakland, California. Kids might even work for a while and later return to get more education, when they are ready. Giving students such options will make them less likely to feel that high school is a prison they must endure until they are grown up enough to go out on their own.

When a person is 14 or older—however old he or she may be—he or she should have access to a personalized learning counselor, who can provide advice about available educational options. As learning becomes more critical for success in the world, people will need individual support from someone who knows their history and the particulars of their

life. Again, technologies greatly expand the range of advice that counselors can use to guide learners. Counselors can direct learners to online resources that guide novices through the initial stages of career choice and development.

A first visit to a counselor should be free and routine for everyone when they reach age 14. Learning counselors would be trained and licensed by the state, just as medical doctors are. The goal would be to develop a learning plan to address each person's interests, needs, and abilities, which would be adapted over the years as the person changed jobs and acquired more knowledge and responsibilities. The learning plan might involve taking online courses, going to a learning center for specialized training, getting a technical certification in some area, joining an apprenticeship program, or learning from computer-based tutorials to enhance particular skills. In any case, the learner should check with his or her counselor at regular intervals to evaluate how things are going and to consider how the plan might be revised.

These examples show how educational leaders need to think about changing schools from within and about how learners can be linked to resources outside schools. Thinking more broadly about technologies can revive our ideas about equity and extend available resources to the nonelites in our society. Our proposals are merely suggestive of the issues that leaders should be considering. Because society has identified education with schooling, we are systematically overlooking many of the resources now available for helping minorities and other nonelites.

Further, society views education reform as something that applies to youth rather than to people of all ages. With a broader view of education, we can begin to think about how to provide educational resources even to people in their 40s, 50s, and 60s.

We are not going to fix education by fixing the schools. They have served us very well in the past, but they are a 19th-century invention trying to cope with a 21st-century society. This is the time for another Horace (or Leticia) Mann to step forward and lead the nation toward a new education system. Our new leaders will have to understand the affordances of the new technologies that have become available in recent years, and to watch for issues and technologies on the horizon. They will need to understand that learning does not start with kindergarten and end with a high school or college diploma—we need to design a coherent lifelong-learning system.

RETHINKING THE ROLE OF GOVERNMENT IN EDUCATION

Historically, the states and towns have been responsible for education in America, with the federal government only playing a supplementary role. The federal government has carried out some programs, such as developing science and math curricula to make the nation more competitive or supporting poor children by providing resources in order to ensure greater equity among children. But teacher's salaries, curriculum materials, and administrative expenses were paid with local funds. When the federal government in recent years has imposed standards on the states and towns, many have regarded this as encroachment on the states' authority. States will try to protect their authority, and this is leading to a backlash against the No Child Left Behind Act.

As we have pointed out, the technological resources that have been developed in recent years introduce new inequities into the education system. Wealthier parents are buying tutoring, computers, and web access for their children, leaving poor children further behind than ever. The states simply do not have the resources to correct these imbalances. They get most of their monies for education from property taxes, and the fact that fewer and fewer households have children makes it very difficult to raise property taxes to pay for education. And the costs of schooling each child have increased rapidly in recent years.

Without stepping on the states' authority, the federal government can try to equalize educational opportunities for all citizens. It can provide robust machines that teach reading to young kids and inexpensive computers with access to the web for older kids. It can provide educational guidance and tutoring for those who cannot afford to buy these services. It can set up apprenticeship programs that help kids make the transition into adulthood, rather than wandering aimlessly, as many now do. It can pay for additional training when people want to change careers. These are all supplemental services that do not step on the states' authority in any way.

There is also an important new role for state government in bringing about a new vision of education for a technology-rich world. If our society is going to support new alternatives for pursuing education, the states need to rethink their mandates of keeping kids in comprehensive schools until they are 16 years old. If we are going to let teenagers pursue other options

besides staying in high school, the states will need to specify what alternatives are acceptable instead of school and what requirements students must meet before pursuing each alternative.

For example, the state might mandate that a student must acquire a specific set of certificates, such as demonstrating an ability to read and do math at an eighth-grade level, before pursuing a full-time job or some other option as an alternative to high school. The states might also monitor the teen's performance in the job and require teens to attend a weekly class where they discuss what they have learned in their work. If the work is not serving as a learning experience for the teens, a guidance counselor may help them find a new job that is of more value to them. If students are taking online courses at a learning center or participating in an apprenticeship program, the state might monitor their progress in similar fashion. The state would still have a responsibility for teenagers, but at the same time, would give them more latitude in pursuing their own education.

We have outlined examples of possible responsibilities that governments could take on, but these are not definitive. Governments should provide guidance to students at the same time that they loosen the reins that are keeping kids in high school, which many of them feel is a kind of prison. It would be wise for governments to put more responsibility on learners to pursue their own learning, but at the same time, it is critical that governments not ignore their responsibility to provide equal access to educational resources for all citizens.

OUR VISION OF THE FUTURE

As education becomes more privatized and commercial, we risk losing the vision promulgated by Thomas Jefferson and Horace Mann of a society where everyone has an equal chance at a good education. Horace Mann was right in predicting that education could provide a path for everyone to become part of the elite. Universal schooling formed the basis for our middle-class society today. But the onset of technology, privatization, and increasing inequality of income is undermining this vision.

Making economic success the central outcome of schooling risks marginalizing the political and moral goals of education. Education is, in many ways, America's civic religion. We use education to work toward our national ideals of equality, opportunity, and democracy. As a society, we need to understand how to balance the need to use schools as engines

of economic competition with our national commitment to equality of opportunity.

According to a recent survey from the Education Trust, America is the only industrialized country in which today's young people are less likely than their parents to earn a high school diploma.[14] Those of us who care about education should do whatever we can to see that our children are educated as best they can to live in a technology-rich society. Even those of us without children should pay attention to this trend. All of us depend on the next generation to support our social services, such as Social Security and Medicare. For the future of America and the welfare of our individual futures, it is important that our society invest in the next generation's education. It behooves all of us to work toward a more equitable system of education.

What role will technology play in our national story of equity and economic development? In the 19th century, Americans developed the public school system to institutionalize our national commitment to citizenship, while at the same time addressing the needs of urban families to care for and educate children in the midst of the Industrial Revolution. Our generation faces a similar, but radically new, design challenge. We are dealing with a mature, stable system of education designed to adapt to gradual change, but ill-suited to embrace radical change. The pace of technological change has outstripped the ability of school systems to adapt essential practices. Schools have fiddled with learning technologies on the margins of the system, in boutique innovations that leave core practices untouched. The emergence of new forms of teaching and learning outside of school threaten the identification of learning with formal schooling forged in the 19th century.

For education to embrace both equity and economic development, we believe that our leaders will have to stretch their traditional practices to embrace the capacity of new information technologies. This will require schools to forfeit some control over the learning processes, but will once again put the latest tools for improving learning in the hands of public institutions (as opposed to the hands of families and learners who can afford access).

Parents and citizens need to start pushing for this more expansive view of education reform. School leaders and teachers will need to understand how learning technologies work and how they change the basic interactions of teachers and learners. Technology leaders will need to work together with educators, not as missionaries bearing magical gifts, but as

collaborators in creating new opportunities to learn. It will take a concerted effort to bring about such a radical change in thinking. If a broader view develops in society, leaders will emerge who can bring about the political changes necessary to make the new educational resources available to everyone. These new leaders will need to understand the affordances of the new technologies, and have a vision for education that will bring the new resources to everyone. We hope these leaders may be reading this book now, and that it can guide them in taking action to address the learning revolution that is upon us.

Notes

Preface

1. de Tocqueville, 2003.

Chapter 1

1. Zuboff, 1988.
2. Murnane & Levy, 1996, report that the gap for men increased from about $5,000 to $10,000 from 1979 to 1993, and the gap for women increased from about $4,000 to $10,000 over the same period. The Bureau of the Census reports that the gap for men increased from about $13,000 to $21,000 from 1990 to 2004, and the gap for women increased from about $10,000 to $16,000 over the same period. Available online at http://www.infoplease.com/ipa/A0883617.html.
3. As evidenced by the explosive growth of Sylvan Learning Centers and Kaplan Inc. See, for example, http://en.wikipedia.org/wiki/Sylvan_Learning and http://en.wikipedia.org/wiki/Kaplan,_Inc.

Chapter 2

1. Brown, 2007.
2. Ito, 2008; Knobel, 2008; Leander & Boldt, 2008.
3. Sadler, 1987. Most adults in America think the phases of the moon are caused by the shadow of the Earth. In fact, the phases are caused by the spatial relation between the sun and moon as seen from the Earth. As the moon goes around the Earth, when the moon is in the direction of the sun, we see a new moon, and when it is in the opposite direction from the sun, we see a full moon. Similarly, most adults in America think the seasons are caused by changes in the distance of the Earth from the sun. In fact, the seasons are caused by the angle of the sun's rays as they hit the earth. The Earth is tilted in its orbit as it goes around the sun, and so in our winter, the direct rays fall on the Southern Hemisphere, and in our summer, they fall on the Northern Hemisphere.