GAME CHANGERS

EDUCATION and INFORMATION TECHNOLOGIES

Edited by **DIANA G. OBLINGER**

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Game Changers: Education and Information Technologies

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FROM THE EDITOR

I would like to thank the many people who made this book possible, particularly Gregory Dobbin for managing the project and Karen Mateer for her research.

—Diana G. Oblinger

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The Knowledge Economy: Challenges and Opportunities for American Higher Education

Paul E. Lingenfelter

THE LATE PETER DRUCKER apparently first used the phrase "the knowledge economy" in his 1969 book *The Age of Discontinuity.*[1] Thirty-two years later, still going strong, Drucker wrote in the November 2001 edition of *The Economist*:

> The next society will be a knowledge society. Knowledge will be its key resource, and knowledge workers will be the dominant group in its workforce. Its three main characteristics will be:
>
> - Borderlessness, because knowledge travels even more effortlessly than money.
> - Upward mobility, available to everyone through easily acquired formal education.
> - The potential for failure as well as success. Anyone can acquire the "means of production," i.e., the knowledge required for the job, but not everyone can win.[2]

By the time Drucker wrote those words in 2001, a great deal of evidence had accumulated to confirm his earlier foresight. Four years later, in 2005, Tom Friedman in *The World Is Flat* essentially announced that Drucker's "next society" has arrived. Friedman argued that the following events and innovations have rapidly and dramatically redistributed economic advantage around the globe:

1. Fall of Berlin Wall (November 9, 1989)
2. Netscape—first mainstream web browser goes public (August 8, 1995)
3. Workflow software—standardized applications, PayPal, eBay, et al.
4. Open-sourcing—Adobe Acrobat Readers, Linux
5. Outsourcing—Y2K, spin-off functions to India
6. Offshoring—China in the World Trade Organization (WTO), capital flows to find cheap labor

7. Supply-chaining—Wal-Mart retailer to manufacturers
8. Insourcing—UPS services linked to shipping
9. In-forming—"Google-like" intelligent searches and data mining
10. "The Steroids"—wireless mobile digital communication[3]

As I write, popular uprisings in the Middle East are the latest example of the political and economic implications of these forces. While events (and especially the pace of change) are frequently surprising, it is not difficult to speculate about the future implications of the knowledge economy for higher education. In this chapter I will focus on four issues and discuss their implications for IT professionals. The issues are as follows:

- Higher education must become less of an elite enterprise; a much larger fraction of the world population will need higher education. Everybody will not need or achieve a four-year degree, but many more people must be educated to a higher standard than previously required. Achieving this goal will require both more effective education of disadvantaged groups and social policies to enable them to pay the costs of higher learning. Moreover, people are likely to obtain higher education throughout life, both as an economic necessity and as a "consumer good." Many young people are likely to make the transition from adolescence to adulthood in "brick and mortar" colleges and universities, but this will not be the end of their higher education.
- Higher education in the United States will continue to be a high social and political priority, but the economic stress of an aging population, health-care costs, growing deficits, and resistance to tax increases will require colleges and universities to increase productivity substantially in order to meet national goals. Achieving productivity gains while enhancing quality is the most significant challenge facing higher education. IT is a critically important resource for meeting this challenge.
- The diversity of knowledge providers and delivery systems requires reengineered postsecondary systems to assure quality and promote improvement. More transparent and clear definitions of degree qualifications and new approaches to accreditation and the assessment and certification of learning are needed.
- The growing importance of educational attainment will require more robust relationships between elementary, secondary, and postsecondary education. Stronger, more meaningful P–20 relationships in standards, professional development, and data systems are essential.

The Imperative for "Mass" Higher Education

When discussing the growing demand for postsecondary education I've frequently heard, "Everybody doesn't need to go to college." Charles Murray, in his 2008 book *Real Education*,[4] elaborated this caution at length, but with a fundamentally tautological argument. Murray maintains that a college education is "real" only when it results in the knowledge and skill traditionally achieved by the most intellectually gifted people who also have enjoyed extraordinary opportunities to develop their talents. If "real education" is defined in elitist terms, quite naturally only a few people will attain it.

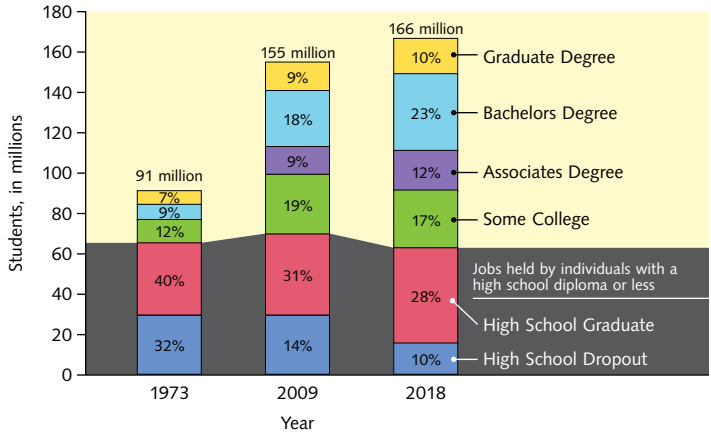
One doesn't have to believe everybody can become Shakespeare or Einstein to realize that Murray's definition of "real education" is far too narrow for the twenty-first century. All people must have more knowledge and skill in a knowledge economy. Moreover, while wisdom and education are far from perfectly correlated, wisdom *requires* knowledge. Better-educated citizens are essential for the world to cope with the political and environmental issues of our era. Nothing in history or current experience suggests we have exhausted the capacity of human beings to learn or their need to benefit from more learning. H. G. Wells's 1919 summation "Human history becomes more and more a race between education and catastrophe"[5] is even more pertinent today.

The facts in the labor market also contradict Murray. Many who deny the growing need for postsecondary education seem to be recalling the workforce of the 1960s and 1970s. Even though many countries have erased the advantages previously enjoyed by the United States workforce, the educational attainment of U.S. workers has grown dramatically. In 1973 it had a labor force of 91 million. High school dropouts held 32 percent of those jobs, and high school graduates held 40 percent. Workers with no college education accounted for 65.5 million jobs in the 91-million workforce. The other 25.5 million jobs (28 percent of the total) were held by college graduates (16 percent) and people with some college (12 percent). See Figure 1.

In 2009, the United States had a labor force of 155 million employees. Only 14 percent of those jobs were held by high school dropouts, and 31 percent were held by high school graduates. Their share of the workforce dropped from 72 percent to 45 percent in 36 years. Workers with no college held 69.8 million jobs in 2009.

By comparison, the number of jobs held by people with college degrees or some college jumped from 25.5 million in 1973 to 85.3 million in 2009. Postsecondary trained workers now account for 55 percent of employees. *Nearly all the job growth in the past thirty-six years has been in jobs filled by people with some postsecondary education.*[6] Anthony Carnevale and his colleagues project

Figure 1. **Higher Attainment Levels Needed for Future U.S. Jobs**



Sources: U.S. Census Bureau, CPS, 1973, 2009; Anthony Carnevale, *Help Wanted* (June 2010): 14.

this trend to continue, resulting in only 63 million jobs for high school graduates or dropouts in 2018, fewer than held by this group in 1973.

College-educated workers are better paid as well as more plentiful. In 2002, a Census Bureau study found that college graduates earned 75 percent more than high school graduates over a lifetime; a 2011 study by the Georgetown University Center on Education and the Workforce indicates that "the premium on college education has grown to 84 percent."[7]

Unsurprisingly, the decreasing value of a high school education has motivated youth to increase their educational aspirations. In an NCES (National Center for Education Statistics) survey of high school sophomores in 2002, 72 percent said they plan to obtain a baccalaureate degree, and 36 percent aspired to a graduate or professional degree. Only 8 percent indicated no plans for postsecondary education.

So *who* must become better educated? Obviously, those who currently are less well educated—the poor, the children of the less well educated, those who for any reason (poverty, race, ethnicity, or recent immigration to the United States) tend not to participate and thrive in postsecondary education. While some seem to think such groups generally have lower academic ability, the facts indicate otherwise.

The college *participation rate* is high for students from high socioeconomic-status (SES) families, regardless of academic ability and preparation. The college participation rate is substantially lower for students from low

Figure 2. **College Participation by Socioeconomic Status (SES)**

		SES Quartile	
		Lowest	Highest
Achievement Quartile	Highest	78%	97%
	Lowest	36%	77%

Source: U.S. Department of Education, February 2001.

socioeconomic-status families, even when they are high in academic ability and preparation (see Figure 2).[8]

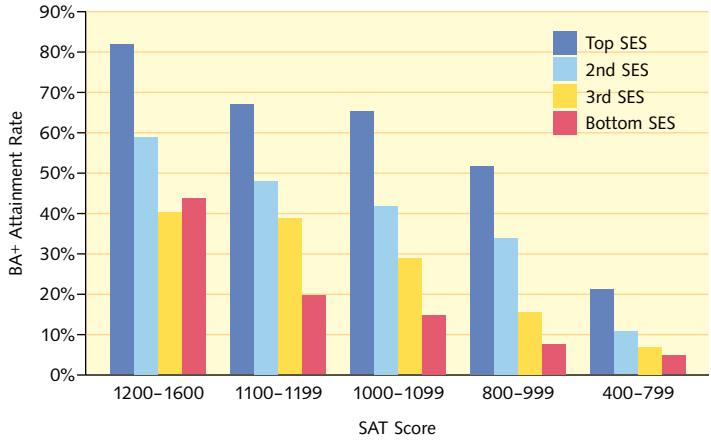
The college *graduation rate* is even more dramatically influenced by socioeconomic status. Using data from the National Education Longitudinal Study to examine the graduation rate at a BA or higher level, Anthony Carnevale found that lower SES students at every level of academic ability obtain the baccalaureate degree at a substantially lower rate than students with higher SES and comparable SAT scores.[9]

As shown in Figure 3, the most dramatic and worrisome differences are for the large number of average students, those with an SAT score between 1000 and 1100, roughly one standard deviation above the average of 1000. Roughly 65 percent of high SES students in the average-ability group obtain a BA or higher degree. About 40 percent of students in the second quartile of SES with average academic ability obtain a BA or higher, and fewer than 20 percent of average-ability students in the lowest quartile of SES obtain a BA or better.

Completing a postsecondary degree or certificate, however, will be just the beginning. As we've learned in the past quarter century, every worker—and especially every professional worker—must continually acquire new knowledge and skills in order to avoid occupational obsolescence. U.S. Department of Education surveys have found that among adults, better-educated people most frequently acquire further education. Education is a growth industry, without a doubt. The relevant questions are, Who will provide educational opportunities, through what means will they be provided, and how valuable, how productive, will they be?

Implications for IT professionals: While IT professionals are needed to make many contributions to more widespread educational attainment, the

Figure 3. **Degree Attainment by SAT Scores and SES**



Source: Anthony P. Carnevale, "A Real Analysis of *Real Education*," *Liberal Education* 94, no. 4 (Fall 2008): 58.

most fundamental of these may be the development of more effective *knowledge-providing* data systems to inform educators, policy makers, and the public. The mobilization of public commitment to educational improvement requires reliable information about educational attainment and the effectiveness of instruction; sustaining that commitment requires evidence of continuing progress. Two crucial recent developments serve these purposes: statewide longitudinal data systems to monitor student progress over time and among schools, and the Common Education Data Standards to provide a shared, consistent P–20 vocabulary.[10]

Widely cited educational information (including the above statistics on the relationship between SES status, academic ability, and educational attainment) has been most often available only through survey research using national samples. In *particular places* (schools, cities, and states), educators and the public have lacked reliable, comparative information about educational achievement due to inconsistent data definitions and our inability to examine the progress of groups of individual students as they move among schools, colleges, and universities. It is in *particular places* where human effort is needed to yield improvement. In a country where retailers have detailed information on the buying patterns of customers and lenders can almost instantly qualify or disqualify a person for a loan, we have found it quite difficult to know how many students finish high school or college on time, or how students from particular schools fare in successive steps of the educational journey.

These problems have been politically, not technically, difficult to solve, but we are making progress. IT professionals need to support such efforts. They also need to build public confidence in our abilities to provide and continually improve the privacy safeguards required for education and the many other important areas of life where personal information is stored and analyzed in data systems.

The Demand for Productivity Gains in Education

Some of those who deny the need for mass postsecondary education are surely worried about its cost. And those who affirm the imperative for mass higher education are likely worried that recent trends suggest society won't be willing to pay what is required. A little history may be useful for understanding the situation.

From 1961 to 2000, almost without pause, postsecondary education in the U.S. grew in both enrollments and publicly provided revenues. In those forty years, state funding for operations grew from $1.4 billion to $60.7 billion, increasing dramatically each decade. The fastest growth occurred in the 1960s, but it didn't stop. From 1970 to 2000, enrollments grew from 4.5 to 8.6 million, and state support per FTE (full-time equivalent) student in public institutions generally kept pace with enrollment growth and inflation—falling a bit in recessions, but recovering afterward. Tuition and fee charges generally grew faster than inflation during recessions and then remained at the higher level, even after state support recovered.

By 2000, revenues from state support and tuition reached an all-time high of $11,371 per student (2010 dollars), and 29 percent of the total came from tuition and fees. By comparison, in 1985 total revenues were $9,753 (2010 dollars), and 23 percent came from tuition and fees.

Things have changed in the past ten years, and they changed in ways that may provide a view of the future. Public FTE enrollments grew by 35 percent from 2000 to 2010 (8.6 to 11.6 million), the fastest ten-year growth rate since 1970. But after the recession of 2001, state support stagnated at $70 billion from 2002 to 2004. The growth of state support resumed in 2005, reaching $85 billion in 2008. Then, however, the Great Recession of 2008 effectively ended growth in state funding for the current decade. Federal stimulus funds totaling $7 billion were needed to supplement state revenues and sustain state appropriations for higher education at $85 billion in 2009 and 2010. Due to enrollment growth, constant-dollar state support per student fell to $6,451 by 2010, the lowest level in twenty-five years. Total-per-student revenues fell to

$10,732 (below the 2000 peak, but well above 1985 levels), and 40.3 percent of educational revenue came from tuition and fees.

So while the twenty-first-century economy is demanding ever-higher levels of educational attainment, the United States irrationally seems to be disinvesting in higher education. Some worry these trends signify the abandonment of public education as a priority. I believe that pessimistic view is unwarranted; such trends instead signify the convergence of several factors that are forcing difficult choices and a broad restructuring of public finance and public commitments.

The only group in the U.S. population not expected to grow in the near and intermediate future is that of the prime working years—from ages 25–55. Retirees needing more health care will grow enormously, and students needing education will grow steadily but more modestly. The adverse impact of these demographics is compounded by persistent health-care-cost escalation, inadequately funded pension systems, increased longevity, and tax policies designed for a different economic era.

In 2005, David M. Walker, then comptroller general of the United States appointed by President George W. Bush, projected future federal deficits and spending in 2040. His projections assumed we meet federal obligations for Social Security, Medicare, and Medicaid; sustain current domestic, international, and military spending at the rate of GDP (gross domestic product) growth; and extend all the Bush administration tax reductions now scheduled to expire in 2013. Walker projected that by 2040, interest payments on the federal debt would nearly equal all federal revenues, spending would equal 40 percent of GDP, and revenues would equal less than 20 percent of GDP. In sum, annual spending would equal 200 percent of revenues. This is the problem, no longer avoidable, that now convulses the political process in Washington. Mr. Walker and others have told us it was coming.

The state piece of the resource shortage is driven mostly by four factors: Medicaid, state pension systems, enrollment growth in both higher education and K–12, and the misfit between many state revenue structures and current economic activity. (For example, Internet sales are often not taxed; more spending today is on untaxed services, not taxed goods; and states with high capital gains taxes experience dramatic revenue swings in economic cycles.) Donald Boyd of the Rockefeller Institute, working with The National Center for Higher Education Management Systems (NCHEMS), has analyzed structural deficits in the states for some time; the situation is deteriorating, not improving.[11]

The pressure for increased educational attainment is colliding with the pressures for honoring pension commitments, for providing health care to seniors and the poor, for public safety, for rebuilding the nation's infrastructure, for research and development, for energy autonomy, for avoiding tax increases,

and for maintaining the international security and military commitments of the United States.

To make education the lowest priority among all these competing claims on the public purse would be to abandon hope for the future of the United States. Such a public policy decision is inconceivable given the clear personal rewards from education and the human instinct to care for one's progeny. An enduring and growing commitment of state and federal support to education will be needed to meet all of our national goals. But productivity gains in education, both K–12 and higher education, are essential.

The Dilemma of Educational Productivity

Largely because the "price" of higher education (both public and private tuitions) has grown much faster than inflation, the public generally believes that U.S. higher education is generously funded. In those institutions educating the most academically able and high SES students, U.S. colleges and universities *are* generously funded. Our funding is less generous and less adequate for community colleges and other less-selective institutions that educate large numbers of students.

Higher education costs have been explained and justified in many ways. Howard Bowen's revenue theory of spending explained that in pursuit of an infinitely expandable good (knowledge and quality), colleges and universities will spend, justifiably perhaps, all the revenues they can acquire.[12] For decades, educators have argued that productivity gains are infeasible in labor-intensive services such as education, based on the 1966 analysis by William Baumol and William Bowen in *Performing Arts*.[13] More recently, in *Why Does College Cost So Much?*, Robert B. Archibald and David H. Feldman argue that the law of supply and demand (skilled professionals are being paid more), increasing living standards, competition for students, and growing demands for quality enhancements are driving costs inexorably higher.[14] And as noted previously, tuitions increase when states fail to keep up with cost and enrollment increases in public colleges and universities.

The initial public policy response to the rising cost of higher education has been to provide more student aid. In the late twentieth century, state and federal student-need-based aid programs, loan programs and, later, merit scholarships and federal tax credits were established to aid students. During the Bush administration, Pell Grants were increased modestly, and new programs rewarding academic preparation and achievement were established (then later disestablished). The Obama administration set out to make Pell an entitlement

and significantly increase the maximum award. While these efforts all aided access, recent growth in enrollments and Pell eligibility have produced skyrocketing, clearly unsustainable budget requirements.

Public policy in 2011 has clearly shifted from financing the cost spiral to fighting it. Congress and the Obama administration are reevaluating federal student-assistance policies. The states are launching initiatives to increase college completions and simultaneously reduce the cost of each degree. A solution to the productivity dilemma must be found in order to meet national goals for educational attainment.

Implications for IT professionals: The idea of computer-assisted instruction as a means of achieving greater efficiency and quality has been around since PLATO (Programmed Logic for Automated Teaching Operations) was conceived in 1960. Although a 1976 book in my office library is entitled *Presidents Confront Reality: From Edifice Complex to University Without Walls*, the rate of progress in developing and implementing computer-assisted learning tools seemed glacial for thirty or forty years. It has now accelerated from a crawl to a gallop. For example, Netscape, the first mainstream browser, did not exist when today's high school seniors were born. Sixteen years later, they and their grandparents check facts on handheld devices in seconds.

At the ACE National Conference on March 6, 2010, William Bowen, coauthor of *Performing Arts,* indicated that, because of the contributions of information technology, he no longer believes productivity gains in education are impossible. Other chapters in this volume will explore that potential, so I will simply observe that information technology can help higher education achieve productivity and quality gains *both* through innovation in instruction and better information for the management of resources. Common data standards and statewide longitudinal student-data systems are also a critical resource for increasing productivity.

More Attainment, *Higher* Quality

The drive for mass educational attainment raises legitimate concerns about quality. Inflated grades or, worse, inflated degrees are no substitute for authentic knowledge and skill. Expanding participation and attainment requires helping average—perhaps even marginally prepared—students succeed at unprecedented rates. State and federal governments have provided incentives and supports for institutions to enroll such students, but the record of student achievement is unsatisfactory. Many accredited institutions (both traditional and "innovative") have poor graduation rates, and graduating students are not

always adequately educated. Academic leaders associated with Liberal Education and America's Promise (LEAP), an initiative of the Association of American Colleges and Universities, have clearly called for *higher* levels of student learning, not simply avoiding the compromise of prevailing standards.

We used to solve the quality-assurance problem by looking at inputs, student quality, faculty quality, library books, facilities, and the like. While inputs still matter, the old models no longer work well, especially for online instruction. In distance learning, faculties are usually temporary, not permanent, employees, and students also participate in episodic ways. Although the distance-education community has defined quality standards for program operations,[15] the use of these standards by accreditors and states is not widely visible.

Traditionally, we have measured student and institutional work by seat time rather than learning (time is the constant, learning the variable), obviously a problem for distance-learning programs. A general consensus is emerging that higher education should focus on generating and certifying knowledge and skill, regardless of the means or duration of instruction. But we lack transparent, generally accepted standards and assessments for knowledge and skill (most especially for nonprofessional degrees), and it is difficult to wean ourselves from the financing system that has based student prices and institutional subsidies on the acquisition of student credit hours.

The growing practice of enabling students to more easily gain credit for prior learning is a welcome development as a means of increasing both productivity and attainment. For its potential to be fully recognized we need (a) more widely accepted standards and assessments of course-equivalent or degree-equivalent knowledge and skill, and (b) appropriate prices for certification where there is minimal or no instruction so that students and those providing financial assistance are not inappropriately exploited.

Both explicit academic standards and the pricing problem are formidable challenges, but we are making some progress on the former. The Bologna Process in Europe, the Degree Qualifications Profile in the United States, and "tuning" (the development of clear learning objectives within a discipline) are interinstitutional, policy-level efforts to achieve common definitions of degrees and ease transferability among institutions. LEAP is challenging institutions and students to pursue the learning outcomes people need to be productive, responsible citizens in the twenty-first century. The Presidents' Alliance; the Voluntary System of Accountability (VSA), sponsored by the Association of Public and Land-grant Universities (APLU) and the Association of State Colleges and Universities (AASCU); the Voluntary Framework of Accountability (VFA), developed by the American Association of Community Colleges (AACC) and College Board; and the National Association of Independent Colleges and Universities'

(NAICU) U-CAN framework are all efforts to focus on enhancing learning and student success within institutions. The National Institute for Learning Outcomes Assessment (NILOA) is surveying the evolution of institutional practices and promoting both improvement and greater transparency.

Implications for IT professionals: The use of IT to achieve greater instructional efficiency becomes possible only when faculty collaboratively define explicit learning objectives, develop instructional materials to enable students to achieve them, and create the tools necessary to assess outcomes. Collective faculty work (together and with IT professionals) is essential; productivity gains require overcoming the robust tradition of professor as soloist. Collaboration and creativity are not antithetical, just as standards and well-defined foundational knowledge and skill are not irreconcilable with diverse views, nuance, and legitimate intellectual debate. While it is difficult for me to imagine effective higher education without discussion and argument, it is increasingly evident that information technology can play a useful role in virtually every aspect of the learning process, including online seminars and conversations.

Others are better prepared to cite the best work in the field and elaborate on significant past or potential contributions, but I can share the perspective of an interested, non-specialist bystander. Many groups of faculty have made great progress in developing clear objectives, aligned instructional materials, and useful non-standardized and standardized approaches to assessment. With the help of IT professionals in employing technology, educators are getting much better at the efficient transmission of knowledge.

The next frontier seems to be using information technology for improving the speed and quality of learning for particular individuals. The Open Learning Initiative at Carnegie Mellon, the NEXUS Research and Policy Center, and others are collecting and analyzing data on student interactions with computer-based learning materials as a means of improving their design in order to accelerate and deepen learning. A growing movement to improve remedial/developmental education is employing diagnostic assessments to identify knowledge gaps and close them more efficiently with well-focused teaching strategies. And with support from the William and Flora Hewlett Foundation and the Bill & Melinda Gates Foundation, the Learning Resource Metadata Initiative (http://www.lrmi.net) will specify the properties of learning resources in a way that can help Google, Yahoo!, and Microsoft Bing be more effective tools for teachers and students. Creative Commons and the Association of Educational Publishers are co-leading the project.

These efforts are headed toward a vision of instruction on a massive scale customized to the goals and current characteristics of individual learners. It is hard to know whether the most difficult challenge in such a vision will be

assembling a broad, deep, and credible collection of learning materials, or ascertaining the constantly changing needs of individual learners and providing instructional materials tailored to those needs. But the vision is exciting; even if it is only partially realized, these efforts could be extremely valuable.

Stronger Relationships between Elementary, Secondary, and Postsecondary Education

Authentic, widespread postsecondary attainment cannot be built on a shaky foundation of elementary and secondary education. Of course, when criticized for failing to prepare students for postsecondary success, K–12 educators can and do deflect the criticism to the colleges and universities that prepare teachers and school leaders. Obviously, reciprocal finger-pointing is foolish; higher education and K–12 education are utterly interdependent. The sectors share a common mission that can be achieved only through deep and extensive collaboration.

The California Partnership for Achieving Student Success (Cal-PASS), founded in 1998, is an exemplar of such collaboration. It began by collecting and sharing anonymous student transcripts and performance information among K–12 schools, community colleges, and universities. (The resulting database now holds over 430 million records from over 8,200 educational institutions.) In an early use of these data, faculty from the Grossmont-Cuyamaca Community College District in El Cajon, California, met with local high school faculty to explore the reasons so many (67 percent) students who received good grades in high school English required remediation in college.

After developing relationships of mutual respect and trust, the K–12 and postsecondary faculty determined that high school English instruction was not preparing students to critically read, develop, and employ expository texts, the predominate focus in much of college work. A systematic effort to address this issue in a pilot group of high schools has materially increased student performance and reduced students' placement in postsecondary remedial courses. The Cal-PASS project, now managed by the Institute for Evidence-Based Change, also includes K–12/postsecondary collaboration in mathematics. This kind of work—faculty dialogues to improve instruction informed by student performance data—should become commonplace in every state and every sector of education.

The development of Common Core State Standards in mathematics and English language arts by the Council of Chief State School Officers (CCSSO) and National Governors Association (NGA) offers an enormously promising

opportunity to improve the effectiveness and productivity of education in the United States. The initiative has aspired (1) to define the knowledge and skills in English and math that, at the completion of high school, would signify that a student is ready for success in college or a career; (2) to define the learning progression through elementary and secondary education needed to achieve college and career readiness; and (3) to provide valid, formative, and summative assessments of student progress toward college and career readiness through each stage of elementary and secondary education.

The guiding principles behind the standards have been "fewer, clearer, higher, evidence based, and internationally benchmarked." Virtually all who have studied the Common Core State Standards agree that the capabilities of U.S. high school graduates will be dramatically higher if these learning objectives are widely achieved. Significant educational progress may be within our grasp if educators in the United States can stay tightly focused on these learning objectives and develop curricula and instructional approaches that will help students achieve them in far greater numbers. The absence of clear, common, and parsimonious learning objectives as well as accepted metrics for assessing achievement surely has contributed to reform movements dominated by contention, rather than the pursuit of common purposes. Well-defined fundamental learning objectives, supported by widely accepted "yardsticks" for assessing student achievement, could become a constructive, enormously powerful tool.

Implications for IT professionals: The Common Core State Standards for mathematics and English language arts and the Common Education Data Standards are creating new opportunities to help U.S. educators meet the challenges of the knowledge economy. Increasingly, information technology can help accelerate educational progress by providing better information about student needs and student performance to instructors, educational leaders, and policy makers.

Explicit learning objectives and assessments and "standard" data on educational achievement are clearly essential in order for information technology to be most useful. They are also essential for achieving widespread educational attainment, but they are not ends in themselves. The "end" of education is not the acquisition of a fixed body of knowledge, but the ability to apply knowledge and skill to the problems of life and to the exploration of new frontiers. These capabilities are the coin of the realm in the knowledge economy.

While the potential of these opportunities is exhilarating, it is sobering to contemplate the scope of human knowledge (and ignorance) and the uncertainties and debates we must navigate as researchers and instructors in order to realize their potential. Real progress will require long, serious conversations

about questions of priority, scope, and sequence, but given time and goodwill, real progress is within our grasp.

Notes

1. Peter F. Drucker, *The Age of Discontinuity: Guidelines to Our Changing Society* (New York: Harper and Row, 1969).
2. Peter F. Drucker, "The Next Society," *The Economist* (November 1, 2001), http://www.economist.com/node/770819.
3. Thomas L. Friedman, *The World Is Flat: A Brief History of the Twenty-First Century* (New York: Farrar, Straus & Giroux, 2005).
4. Charles Murray, *Real Education: Four Simple Truths for Bringing America's Schools Back to Reality* (New York: Random House, 2008).
5. H. G. Wells, *The Outline of History Part II* (George Newnes, 1919).
6. Source: Anthony Carnevale, Georgetown University Center on Education and the Workforce's Analysis of Macroeconomic Advisers (MA) Long-Term Economic Outlook, March 2009.
7. Anthony P. Carnevale, *The College Payoff: Education, Occupations, Lifetime Earnings* (Washington, DC: The Georgetown University Center on Education and the Workforce, 2011).
8. Source: U.S. Department of Education, February 2001.
9. Anthony P. Carnevale, "A Real Analysis of *Real Education," Liberal Education* 94, no. 4 (Fall 2008): 54–61, http://www.aacu.org/liberaleducation/le-fa08/documents/le-fa08_Carnevale.pdf.
10. More information on the Common Education Data Standards can be found at http://commoneddatastandards.org/ and at http://ceds.ed.gov/.
11. Don Boyd, *State Fiscal Outlooks from 2005 to 2013: Implication for Higher Education* (Boulder, CO: National Center for Higher Education Management Systems, 2005).
12. H. R. Bowen, *The Costs of Higher Education* (San Francisco: Jossey-Bass, 1980).
13. W. J. Baumol and W. G. Bowen, *Performing Arts—the Economic Dilemma* (New York: The Twentieth Century Fund, 1966).
14. Robert B. Archibald and David H. Feldman, *Why Does College Cost So Much?* (New York: Oxford University Press, October 2010).
15. See, by way of comparison, http://net.educause.edu/ir/library/text/CEM9613.txt.

As President of the association of State Higher Education Executive Officers (SHEEO), **Paul E. Lingenfelter** *has focused on increasing successful participation in higher education, improving student learning, finance, and building more effective relationships between K–12 and postsecondary educators. He previously was Vice President of the MacArthur Foundation and Deputy Director of the Illinois Board of Higher Education.*
