Rethinking K–20 Education: Transformation for a New Age

The industry is poised for profound change. However, the change needed to deliver a new vision will not be easy in an environment that has a history of shunning radical transformation.
Falling Behind in the Digital Age

Over the past 25 years, the world has changed faster and with more complexity than ever before. The most significant force is the advent of the Internet and the rapid advancement of technology. Such a radical global transformation has required people to learn new theories and knowledge that did not exist even two decades ago, new skills that now have a prominent role in our daily lives, and new technological competencies. However, our education systems, particularly K–20, have not kept pace. Stuck in the industrial age, our schools continue to teach content that is no longer relevant, using pedagogical methods that no longer benefit young people’s evolved minds. In many ways, the skills of a secondary-school graduate today are similar to the skills of a graduate 20 to 40 years ago, making education one of the few industries in the world where significant evolution has yet to occur.

Younger generations need to be equipped with a new learning framework.

Most K–20 institutions have adapted their curricula over the years, adding courses pertaining to 21st-century skills, such as entrepreneurship and computer studies. Others have incorporated technology into the classroom, creating course websites or providing students with laptops. However, this does not qualify as a significant evolution. A significant evolution is a radical transformation of educational institutions’ operating models in direct response to environmental changes, whether it be a shift in consumer behaviors, a launch of new technologies, or the development of new regulatory policies. We need to transform the idea of education systems so they are understood as engines not only for employment and economic growth but also for empowering students to take control of their environments.

Around the world, the measures used to assess students do not account for contemporary ideas of what constitutes a quality education, nor do they look at the whole learner. Instead, national policies and international standards are encouraging educators to take a narrow view of human development and, in the process, restricting the impact of education.

If education is to become the most powerful engine of social change, we must put the development of learners as whole human beings at the core of teaching and schooling.

In the private sector, business leaders constantly rethink their operating models, fighting to stay relevant with customers. This has not happened in education. K–20 institutions are stuck in an ecosystem that makes significant evolution extraordinarily difficult, and the inertia has had an impact on an array of societal and macroeconomic issues around the world:

Insufficient improvements in fundamental skills. According to the European Commission’s Rethinking Education initiative, 73 million adults have only a low level of education, and nearly 20 percent of 15-year-olds lack sufficient reading skills. The world has become more complex and interconnected while our educational system has remained stuck in the industrial age. Younger generations need to be equipped with a new learning framework that is aligned with the transformed strategic environment that awaits them. “(Public education) systems were

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1 K–20 is defined here as education from kindergarten for four- to six-year-olds through university for students of 17 and above.
2 Rethinking Education strategy, European Commission
developed in large part to meet the labor needs of the Industrial Revolution, and they are organized on the principles of mass production,” said Sir Ken Robinson, author, speaker, and international advisor on education. “The problem is that these systems are inherently unsuited to the wholly different circumstances of the 21st century.”

**More unemployed youth.** Young people are three times more likely to be unemployed than adults, and almost 73 million of them worldwide are looking for work. Furthermore, job vacancies are staying unfilled much longer today than they did before the global financial crisis—an average of 25 business days versus 14 days. Although these findings are primarily attributed to macroeconomic factors that deter hiring, they also indicate a potential mismatch between the new-age skills that employers need and the obsolete, industrial-age knowledge acquired through formal education. According to the US Bureau of Labor and Statistics, 19 million jobs in the United States will be replaced by artificial intelligence by 2024 (see figure 1). The new education paradigm needs to take into account the profound change taking place across the 21st-century landscape.

**Figure 1**

**Millions of jobs could be lost to artificial intelligence**

![Job Activities Replacement Chart](chart.png)

Required skill level

Learning and intelligence share of activities

- Note: The skill-level rating analyzed about 800 occupations along 37 activity archetypes.
- Sources: US Bureau of Labor and Statistics, A.T. Kearney analysis

**Dropout rates.** While the overall dropout rate has declined (in the United States alone, it decreased from 12 percent in 1990 to 6.5 percent in 2014), the numbers vary dramatically by race and ethnicity, gender, and income level. Hispanic students in the United States have consistently had the highest dropout rates. Today, that number is unacceptably high at 14 percent. Students from low-income families had a five times greater risk of dropping out than their high-income peers. In the United States alone, 12 million children are expected to drop out of formal education in the next 10 years.

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3 Global Employment Trends for Youth 2015, International Labour Organization
5 National Center for Education Statistics, US Department of Education
Lack of progress in encouraging early-childhood education. Better early-childhood education can shape the success of the entire education system. Nobel Prize-winning economist and University of Chicago professor James Heckman, who has dedicated much time to researching early childhood, found that children of mothers who graduate from college score much higher on cognitive tests at age three than those whose mothers drop out of high school—proof of the advantage for young children who live in rich, stimulating environments. Interest in education at an early age encourages lifelong learning, which is another key policy objective in many countries. Early childhood programs are also valuable resources for encouraging parents to re-enter the workforce, thereby activating a key resource in the population needed to stimulate economic growth.

“There is hard evidence that non-cognitive—or character—skills matter greatly.”

—Professor James Heckman

There are many other education issues, of course. But these four are compelling enough to support the call for a new vision. This paper examines some ideas for this new vision and the implications for the major stakeholders in the education ecosystem. We especially focus on one overarching question: is education in its traditional form still relevant?

Defining a New Vision

As popularized by Daniel Pink’s best-selling book, A Whole New Mind: Why Right-Brainers Will Rule the Future, we know that the world is at a turning point—between a digital age where knowledge, logic, and analysis thrived and a conceptual age where creativity, innovation, and design skills are more strongly valued. “The future belongs to a different kind of person with a different kind of mind: artists, inventors, storytellers—creative and holistic ‘right-brain’ thinkers whose abilities mark the fault line between who gets ahead and who doesn’t,” Pink contends.

As a result, today’s focus should be not only on closing the skills gap of the digital age, but also on ensuring that students acquire the skills to succeed in the conceptual age. In this paper, we discuss the following factors for achieving this goal (see figure 2 on page 4):

- **Curriculum.** What should we teach?
- **Measurement.** How do we effectively measure and compare the quality, efficiency, and results of education systems throughout the world?
- **Technology enablers.** How do we adapt to the technology-induced “rupture” in the way education is delivered? How can we take advantage of the possibilities offered by new technologies to build a better education model for the greater good?
- **Funding.** How do we ensure proper funding for education? What is the ideal economic equation?
- **Ecosystem.** Who plays a role in education at all levels, from defining the curriculum to deploying infrastructure and funding?
Curriculum: Evolving What—and How—We Teach

We define curriculum as a set of organized courses and modules with intended learning outcomes. A curriculum has three closely connected components: theory and knowledge, skills and competencies, and values and character. Some components are isolated, but most overlap. For example, students understand geography via theory and knowledge skills, but there is an overlap when they practice cultural awareness—a skill needed to thrive in today’s world—as they draw from what they have learned in a geography course.

Theory and knowledge

In the simplest terms, theory and knowledge are what you know, for example literacy and numeracy. Traditionally, learning institutions have taught this deductively, using information that already exists. Education has focused on this component with the belief that students who acquire and retain more knowledge are better able to succeed in the world. However, in the digital age, knowledge is a commodity: information is ubiquitous and accessible at the touch of a button. Students do need some retained knowledge to draw connections and conclusions, but concentrating on this component is no longer practical; a broader curriculum is needed. The main challenge that schools and education systems will face is deciding which core bases of knowledge to prioritize and which ones to eliminate to accommodate other skills and competencies.

In recent years, technological competency—the ability to use technology to apply knowledge—has become a fundamental skill. This includes basics such as writing an essay on a word.
processor to more advanced uses such as iterative product development and manufacturing by programming Python algorithms for 3-D design and printing. These skills are the foundation of success in our technology-driven society.

The continuous revolution in technology, in particular big data and artificial intelligence, begs the question of whether education institutions are delivering the right technological competencies. Microsoft recently announced an ambitious undertaking, vowing to “solve” cancer within the next 10 years by reprogramming diseased cells. According to Microsoft, humans have published enough cancer research; the cure now lies in coding and directing complex problem-solving algorithms that can mine this information to find the causal links to cancer and use pattern recognition to identify effective methods to treat cancer. In this world as described by Microsoft, will there be enough people with the relevant technological skills? Microsoft has established an all-encompassing education transformation framework, dependent on the adoption of several Microsoft tools that aim to support its vision (see figure 3).

Figure 3
Microsoft’s Education Transformation Framework

Skills and competencies

Continuously evolving skills and competencies are essential to survive and thrive in a constantly changing world. They are represented by the direct application of theory and knowledge in the real world—the capacity to translate information into insights and ideas that are relevant to the environment. Many skills and competencies are needed today, including leadership, problem solving, critical thinking, collaboration, empathy, design thinking, flexibility, creativity, diplomacy,

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6 How Microsoft Computer Scientists and Researchers Are Working to “Solve” Cancer, Microsoft
listening, teamwork, public speaking, cultural awareness, entrepreneurialism, conflict resolution, and facilitation.

In the digital age, skills and competencies have enormous importance. Creativity is a good example. Pink describes right-brain creativity as “the ability to synthesize knowledge and develop inventive solutions to complex challenges.” Synthesis is paramount to innovating in the digital age. Without it, we lack the ability to connect the dots from our repository of knowledge to the phenomena of the real world. Take computer programming as an example. Schools can teach the basic concept of writing code (theory and knowledge) and allow students to try their knowledge on a computer (technological competency). But it is only when a student creates something, such as a mobile phone app, that society benefits.

In another important study, general systems scientist George Land looked at education and creativity using a NASA test that was developed to identify innovative engineers and scientists (see figure 4). In 1968, he tested 1,600 five-year-olds and then retested them when they were 10 and 15 years old. At age five, 98 percent tested as creative geniuses. By age 10, the number had dropped to 32 percent, and by age 15, it had plummeted to 10 percent. When the same test was administered to 280,000 adults, only 2 percent registered as creative geniuses. Land concluded that noncreative thinking is learned. This was tangentially observed by Albert Einstein, who said, “It is a miracle that curiosity survives formal education.”

The World Economic Forum's New Vision on Education: Fostering Social and Emotional Learning through Technology report also highlights the importance of social and emotional learning and the way technology enables those skills: “To thrive in the 21st century, students need more than traditional academic learning. They must be adept at collaboration, communication and problem solving, which are some of the skills developed through social and emotional learning.”

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**Figure 4**

**Study indicates noncreative behavior is learned**

**George Land’s creativity test**

Percentage of creative geniuses

<table>
<thead>
<tr>
<th>Age</th>
<th>5</th>
<th>10</th>
<th>15</th>
<th>Adult</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>98</td>
<td>32</td>
<td>10</td>
<td>2</td>
</tr>
</tbody>
</table>

Note: A National Aeronautics and Space Administration (NASA) test, given to 280,000 adults to select innovative engineers and scientists, was given to 1,600 children in 1968.

Sources: Breakpoint and Beyond: Mastering the Future Today by George Land, A.T. Kearney analysis

1 Breakpoint and Beyond: Mastering the Future—Today, George Land
A handful of institutions have adopted innovative models in isolation. For example, the Reggio Emilia Approach is a collaborative educational philosophy that places teachers, parents, and students as active contributors to the learning process—the outcome often being significant improvements in social and emotional proficiencies. United World College is another example of an institution offering an all-encompassing, value-based education through its unique community participation and outdoor learning program. The Abu Dhabi Music and Arts Foundation has also innovated in this field by using various art forms to build understanding and learning ability in curriculum subjects.

Ashoka, the world’s largest network of social entrepreneurs and institutional change leaders, believes the challenges of the planet can be overcome if everyone can become a change-maker—someone who is taking creative action to solve a social problem. Change-making requires empathy, thoughtfulness, creativity, action, and collaborative leadership. Although these skills are essential to our thriving, they are almost entirely absent from the educational experience of most young people, with often a narrowing focus on reading, math, and academic grades. Ashoka’s vision and mission is to catalyze the transformation of education systems so that every child and adolescent is provided with educational environments and experiences designed to ensure they become change-makers.

In Ashoka’s Changemaker strategy, four skills are highlighted as important:

- Cognitive empathy
- Teamwork to help young people work in a fluid, more open, fast-paced, and sophisticated world
- Leadership that enables students to adapt to an ever-changing world with teams made up of powerful self-initiating change-makers
- Creativity and an entrepreneurial mindset

The United States’ 2016 National Education Technology Plan emphasizes the importance of developing non-cognitive competencies within the school system, including empathy, self-awareness, emotional regulation, social awareness, cooperation, and problem solving. Digital games such as Ripple Effect and The Social Express use virtual environments, storytelling, and interactive experiences to let students try varied responses and roles and then gauge the outcomes without fear of negative consequences.

In Singapore, a social and emotional learning module is taught within a character and citizenship education curriculum. Part of the official Ministry of Education program, social and emotional learning is an umbrella term that refers to acquiring “skills to recognize and manage emotions, develop care and concern for others, make responsible decisions, establish positive relationships, and handle challenging situations effectively.” The module is seen as an essential part of preparing students to live and work as adults in the 21st century.

In Finland, a country at the top of the Organisation for Economic Co-operation and Development Programme for International Student Assessment (PISA) ratings, a new curriculum requires schools to pay more attention to developing calm learning environments, well-being, self-esteem, empathy, and social and emotional skills. These aspects are the focus of the Kilonpuisto Comprehensive School experiment. Conducted during the 2016–2017 school year, the experiment shares effective practices that teach emotional skills and self-awareness and,

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8 Future Ready Learning: Reimagining the Role of Technology in Education, US Department of Education
9 Social and Emotional Learning, Singapore Ministry of Education
in doing so, proves these skills can be integrated into all learning across day-to-day school life. It is teaching students self-awareness, empathy, and compassion as well as helping them recognize their strengths, understand their emotions, develop curiosity about themselves and about life, and understand and empathize with one another. They are learning to put their thoughts and feelings into words and make good choices using the skills they learn and the strengths they discover during the experiment.10

Ashoka Changemaker schools use a variety of approaches depending on the diverse contexts in which they operate (see figure 5). Ashoka is partnering with about 260 schools around the world as well as 33 private and public colleges and universities in six countries. For example, the Changemaker Campus designation is offered to higher education institutions that have embedded change-making as a core value across the institution—from admissions, the curriculum, and career services to community and alumni engagement. Overall, however, there has yet to be widespread reform emphasizing empathy and other “right-brain” skills.

**Figure 5**
Ashoka Changemaker schools use a variety of approaches

<table>
<thead>
<tr>
<th>Primary and secondary schools</th>
<th>Higher education</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Amorim Lima School in Brazil</strong></td>
<td><strong>Tulane University in the United States</strong></td>
</tr>
<tr>
<td>The school hosts students from diverse socioeconomic backgrounds</td>
<td>This comprehensive ecosystem is dedicated to social innovation education and design-thinking methodologies, including the following:</td>
</tr>
<tr>
<td>Classroom walls have been knocked down to create large, open learning spaces</td>
<td>• An interdisciplinary undergraduate minor in social innovation and social entrepreneurship</td>
</tr>
<tr>
<td>Students have significant freedom to learn at their own pace and according to their own interests</td>
<td>• The Phyllis M. Taylor Center for Social Innovation and Design Thinking, which encourages students, teachers, and community members to work together to develop innovative solutions to social and environmental problems</td>
</tr>
<tr>
<td><strong>Riverside School in India</strong></td>
<td>• Robust cocurricular programming that inspires, mentors, and supports student change-makers</td>
</tr>
<tr>
<td>In this innovative environment, students have opportunities to interact with their communities and their city in a constructive manner</td>
<td></td>
</tr>
<tr>
<td>The aim is to enable students to not only learn skills but also understand their potential and responsibilities as citizens</td>
<td></td>
</tr>
<tr>
<td><strong>Hill Preparatory School in Uganda</strong></td>
<td></td>
</tr>
<tr>
<td>Founded for children with special needs, the school fully integrates them with children who do not have special needs</td>
<td></td>
</tr>
<tr>
<td>The school’s emphasis is on nurturing empathy</td>
<td></td>
</tr>
</tbody>
</table>

Sources: Ashoka; A.T. Kearney analysis

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### Values and character

The development of values and character in educational institutions is inherently linked to a discussion on ethics and morals. In the digital age, we have seen more situations that have required ethical decision making. For example, in work that A.T. Kearney and the World Economic Forum collaborated on from 2013 to 2014, the topic of ethics in the use of personal data was studied with governments, the private sector, civil society, and nongovernmental organizations. The ethics of data refers to attributes such as fairness, agency, consent, social justice, and

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10 *Teaching Emotional Skills and Self Awareness in Schools*, HundrED
participation. By embracing ethical practices, individuals can more effectively engage in how, where, and for what purposes their personal information is used. With a focus on ethics (as opposed to privacy, which can be limiting), both the short- and long-term effects of how data is being used to impact the overall lives of individuals and communities can be better understood.

Complex decisions about the use of personal data cannot be made with technocratic solutions alone. Analysis of the issues requires leadership, critical problem solving, and a sense of what is right and how we ought to behave. Similarly, values-based education is needed in conjunction with theory and knowledge along with skills and competencies. The enduring beliefs of what individuals or communities want and how they ascribe worth to those requirements is something that can begin in kindergarten and progress through secondary school and university. A good example is the value that different countries and communities place on the sustainability of the planet. Some believe the ecological issues are a hoax. Others demonstrate almost paranoid behavior: investing in science to colonize other planets because they believe that our world cannot sustain population growth and that environmental catastrophe will inevitably follow.

In the digital age, **knowledge is a commodity**: information is ubiquitous and accessible at the touch of a button.

Measurement: Rethinking Standards and Metrics

Policy makers and practitioners often ask how we should measure education’s effectiveness. The challenge with this question is with the use of the term “education.” Stakeholders across regions and fields have diverse definitions of education and its inherent purpose. While this poses no issues when measuring education on an isolated basis—for example, in a distinctive field or region where the purpose is more commonly agreed upon—it can cause discrepancies when used comparatively.

We have defined four components of measuring the effectiveness of education (see figure 6 on page 10). The first is the **input**, or the curriculum and content being delivered. The second is the **desired outcome**. The input’s effectiveness can only be measured once the outcome has been identified. From a global perspective, the standards and metrics used to measure education’s effectiveness must be derived from key stakeholder groups’ agreement on a general purpose of education. The third component is **measurement**, or the criteria used to evaluate the desired outcome. The final component is the **assessment** used to evaluate the measurement metric. For measurement to be effective, these four elements must be aligned.

**Current measurement tools and limitations**

Various international education league studies exist, the largest and most recognized being PISA. Nearly 500,000 15-year-olds across 65 nations take this two-hour test, the purpose of which is to understand if they are “well-prepared to participate in society.” (The age was chosen because most of these students are on the verge of completing compulsory education and can thus provide a representative measure of K–12 educational effectiveness.) The test focuses on
three domains: math, science, and reading. Results are used in significant policy decisions and educational reforms, including the Common Core standards in the United States. However, questions arise about the importance and relevance of the results, given the asynchronous nature between the test’s purpose and the domains being tested.

A.T. Kearney’s education framework is built on three components in a school’s curriculum: theory and knowledge, skills and competencies, and values and character. The PISA measurement framework tests the first component but not the other two—the components that prepare students to participate in society.

In the book *World Class Learners: Educating Creative and Entrepreneurial Students*, Oregon University Professor Yong Zhao identifies two education paradigms: employee oriented and entrepreneur oriented. The essential difference is that the employee-oriented paradigm uses a standard, prescribed curriculum to produce homogenous workers for large-scale employment (the industrial age) while the entrepreneur-oriented paradigm focuses on supplementary elements, such as creativity, personality, and emotional development (the conceptual age). The PISA test and other international studies measure how effective a country has been at deploying their prescribed math, science, and reading curriculum (an employee-oriented education) rather than the degree to which it has cultivated creative and emotionally aware thinkers (an entrepreneur-oriented education).
Zhao then analyzed the Global Entrepreneurship Monitor (GEM), the world’s largest entrepreneurship study. The 39 countries that participate in GEM also participate in PISA. Comparing the two studies, Zhao found a largely inverse correlation between PISA test scores and entrepreneurial capacity. For our analysis, we selected countries that were involved in both studies in 2012 (see figure 7). We chose the eight top-performing countries on the PISA test along with a randomly selected group of eight countries scoring in the middle and low end. We then divided each country’s “perceived entrepreneurial capabilities” score from GEM by its average PISA result (from math, science, and reading). The findings reveal a sizable gap between the two groups. The countries with the top PISA scores had an average GEM:PISA score of less than half of the mid- and low-scoring countries, indicating a potential shortfall in PISA’s measuring purpose to understand if students are “well-prepared to participate in society.”

If schools continue to focus on theory and knowledge alone, many students will be unprepared to participate in society. Therefore, ensuring these students gain these skills at university will be essential. However, university placements are harder to achieve than ever before, especially for the world’s top universities.

Avanti Learning Centre, a nonprofit in India set up by Ashoka Fellow Akshay Saxena, is a good example of an organization that uses new delivery models to give high-potential, low-income students better access to top universities. Avanti’s operating model focuses on mentoring,
rigorous tutoring, self-study tools, and science- and mathematics-focused training. Rather than traditional teacher-centric delivery, students learn through pre-reading, peer instruction, self-study, and group learning. Much of class time is spent working in small groups to discuss learning material and problem sets. Specific attention is given to material covered on the Indian Engineering Entrance Exams, and once admitted to the program, Avanti Fellows are given free places at leading coaching institutes that specialize in preparing students for college entrance exams. More than 300 volunteers from the Indian Institutes of Technology and other top engineering schools spend more than three hours a week mentoring these low-income students and preparing them for university exams.

A.T. Kearney’s education framework is built on **theory and knowledge, skills and competencies, and values and character.**

**New measurement variables**

The Pearson Learning Curve is the latest innovation in education league tables. However, the analysis only draws on data from cognitive-focused assessments, such as PISA, the Trends in International Mathematics and Science Study, and the Progress in International Reading Literacy Study. If the aim is to measure education’s effectiveness and a student’s employability, all three components of the curriculum should be studied. As mentioned, most studies focus on fundamental skills such as theory and knowledge but miss areas such as entrepreneurial aptitude, creativity, and empathy.

In terms of measuring technological competencies, the International Computer and Information Literacy Study (ICIL) by the International Association for the Evaluation of Educational Achievement is the first international comparative study that emphasizes students’ acquisition of computer skills. “The purpose of the ICIL is to investigate the computer and information literacy amongst young people to support their capacity to participate in the digital age,” according to a recent ICIL publication. “It also addresses the necessity for policymakers and education systems to have a better understanding of the contexts and outcomes of ICT-related education programs in their countries.”

Conducted in 2013, the study assessed the computer and information literacy skills of 50,000 eighth-graders (with an average age of 13.5 years old) in more than 3,300 schools from 21 education systems. The study looked at how students engage with computer and information technology at home and at school and examined the role that schools and teachers play. The study found that only 2 percent of students use their critical thinking and that teachers lack confidence in teaching essential computer skills.

There are no large-scale international studies focusing on values and character. However, the Heckman Equation and other studies demonstrate that this realm of curriculum focus is one of the most important areas for young people. The challenge in assessing these skills is mainly in reliability and how to accurately replicate the evaluation. In addition, the most suitable tool to assess social and emotional skills is not the traditional, low-cost pen-and-paper method but in-person assessments.

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11 ICT is information and communications technology.
Technology: A New Way to Teach

Emerging technologies and trends

We are in an era of unprecedented innovation in education technology. Experts have their eyes on several emerging technologies to support teaching, learning, and creative enquiry (see figure 8). In the next year, cloud computing and mobile apps are expected to reach mainstream use across much of the world. In Asia, several international schools are already using cloud-based services such as Google Apps and Skype while also establishing their own cloud networks to increase access to content from mobile devices, according to a New Media Consortium Horizon Project Regional Report. However, learning analytics are still two to three years away from widespread adoption as individual schools are primarily still in the pilot phase. Many believe that virtual and remote laboratories will be more broadly adopted in five or more years.

Eliminating premiums on content is another milestone brought about by technology. Content is now easily accessible on various digital platforms and no longer entails massive spending. For example, Apple and Google have nearly 120,000 educational apps, most of which are free or affordable. Arizona’s Vail School District has embraced this new trend. “We used to invest hundreds of thousands of dollars every year in the textbook cycle, but we don’t do that anymore,” said Superintendent Calvin Baker. Instead, the 12,000-student district collects digital content

Figure 8
Emerging education technologies have great potential

<table>
<thead>
<tr>
<th>Adoption horizon</th>
<th>K-12</th>
<th>International schools in Asia</th>
<th>European schools</th>
</tr>
</thead>
</table>
| **One year or less** | • Bring your own device  
• Cloud computing  
• Mobile apps  
• Tablet computing | • Cloud computing  
• Games and gamification  
• Makerspaces  
• Mobile apps | • Cloud computing  
• Flipped classroom  
• Mobile apps  
• Tablet computing |
| **Two to three years** | • 3-D printing  
• Games and gamification  
• Learning analytics  
• Makerspaces | • 3-D printing  
• Learning analytics  
• Massive open online courses  
• Personal learning environments | • Games and gamification  
• Learning analytics  
• Massive open online courses  
• Mobile learning |
| **Four to five years** | • Flexible displays  
• Internet of Things  
• Virtual and remote laboratories  
• Wearable technology | • Internet of Things  
• Virtual and remote laboratories  
• Virtual reality  
• Wearable technology | • Personal learning environments  
• Virtual assistants  
• Virtual and remote laboratories  
• Visual data analytics |

Sources: 2014 NMC Technology Outlook for International Schools in Asia, New Media Consortium; A.T. Kearney analysis

12 What Can Disruptive Innovation in Education Look Like?, Comprendio

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from various platforms (often at no cost) and bundles it to create instructional materials. The courses are now in such demand that the district charges 68 partner districts across the state a fee to use them. What previously was one of the district’s biggest expenses is now an income-generating venture.

The availability of technology can significantly improve the delivery of education, but affordability is essential. In several developing nations, affording technology for education is a major hurdle. One noteworthy company that is providing low-cost technology is One Laptop per Child, a nonprofit organization that aims to empower the world’s poorest children through education. The project provides low-cost computers, called the XO laptop, to nearly two million children and teachers in Latin America and another 500,000 in Africa and the rest of the world. The cost was kept low by first rationalizing software and hardware resources and then mass-producing units to achieve economies of scale. Central to the project’s strategy was its partnerships with Advanced Micro Devices, Chi Mei, eBay, Google, Marvell Technology Group, News Corporation, Nortel, Red Hat, and Quanta.

“We aim to provide each child with a rugged, low-cost, low-power, connected laptop.”

—One Laptop per Child website

Despite the tremendous progress, gaps still exist in technology-enabled education models. Ideally, technology should be deployed to support the delivery of theory and knowledge, skills and competencies, and values and character. However, existing educational technologies are largely focused only on theory and knowledge. For example, Khan Academy provides personalized and adaptive content curricula focusing on fundamental literacies only, as do open educational resources such as BetterLesson and Curriki Geometry. What’s missing are technology-enabled tools that focus on values and character or other competencies.

Learners are becoming more digitally connected and are continuously exposed to information and knowledge. In fact, teenagers spend about nine hours a day on screen media. Learning needs to reflect this highly mobile and connected reality of today’s world. Education models must also reconcile with the variety of ways students learn and ensure teaching methods are dynamic enough to impart factual knowledge while also developing procedural knowledge and motivational engagement. Hence, there is a tremendous potential for technology to play a more prominent role in shaping learning and education.

More specifically, learning must be made “on demand” with the following considerations:

❖ Education models and pedagogies must change what and how we teach to match what students need to know and how they learn.
❖ Technology must be embedded into learning to engage, motivate, and inspire learners. The global economy tells us what people need to know and who needs to learn. Advances in learning sciences such as cognitive science show us how people learn. Technology enables us to act on this knowledge by understanding and delivering effective learning.

13 Common Sense Census (2015), Common Sense Media
Twenty-first century learning must shift away from the traditional classroom instruction. Technology-powered education must give students the flexibility to learn in ways that suit their individual needs while simultaneously meeting universal standards of performance.

Technology-enabled learning—a format that blends methods such as lectures, simulations, Web-enhancement, and hands-on desktop experiments to create a rich collaborative learning experience—exposes students to types of learning that used to be impossible to bring into the classroom. Self-learning platforms, digital classrooms, collaborative curricula, remote co-presence, and exposure to authentic situations and environments via augmented reality enable students to learn many practical skills, especially in relation to complex situations. Governments and the private sector have launched several initiatives to bring technology-enabled learning to teachers and students. On the government level, several countries have acknowledged the shortcomings of traditional education systems and are working to prepare their educational systems, racing ahead (or catching up with) new technology. In Australia, for example, the government has adopted several Digital Education Revolution plans, forging “a new digital education for young Australians in the 21st century” and aiming to harness the transformative potential of digital technology to support new approaches to innovative learning that focus on developing 21st-century learning skills.14

Recognizing the power of virtual peer learning, the US Department of Education’s Office of Career, Technical, and Adult Education has funded projects that have established teacher user groups to explore introducing openly licensed educational resources into adult education. This model of professional development recognizes that virtual peer learning can support teachers to change their practice and provide leadership and growth opportunities.15

Private companies also play a huge role in promoting technology-enabled learning and bringing it closer to users. Schoology, a cross-device learning management system that connects people, content, and education systems, is one example of technology that is harnessing the power of social networking to enable interactive and community-based learning and empowering education without geographic boundaries by promoting shareable resources and a collaborative learning experience. For institutions, the platform offers tools to create engaging content, design lessons, and assess students’ understanding based on robust data analytics. For students, Schoology offers an interactive, easy-to-access, and engaging learning environment.

Chesapeake Bay FieldScope, a National Geographic geospatial tool modeled after a geographic information system, allows high school students to explore phenomena at extreme spatial or temporal scales through simulation and modeling.16 Students can trace the tributary network path that connects their location to Chesapeake Bay, adding information to a watershed profile along the way. This allows students to build their identity as citizens of a vast and ecologically important watershed.

Another example of technology that enables different teaching and learning experiences is the London Royal Hospital’s virtual reality surgery training tool. The technology immerses trainee surgeons in an experienced surgeon’s recorded operation. These highly realistic experiences help trainees to familiarize themselves with their working environment and develop soft skills such as communication.17

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14 Beyond the Classroom: A New Digital Education for Young Australians in the 21st Century, Digital Education Advisory Group, Australia Department of Education and Training
15 Future Ready Learning: Reimagining the Role of Technology in Education, US Department of Education
16 Chesapeake Bay FieldScope Resources, National Geographic Society
17 Barts Health to Perform World’s First Live Virtual Reality Operation, Barts Health NHS Trust, 13 April 2016
Transforming assessment

The assessment side has similar deficiencies. Traditional modes of assessment limit learning for both educators and learners. In traditional classroom assessments, an educator routinely gathers information about learning based on what students do in class, ignoring the fact that they have a variety of interests and learn at a variety of paces. Insight into what students do and do not understand tends to be informed primarily through facial expressions of interest, boredom, or puzzlement.

Technology can supplement traditional modes of assessment in several ways:

Using big data to design differentiated learning. For example, data capture from various assessments can give educators access to data points that shape the next learning experience that will be most beneficial for a learner. A dashboard of actual learning gains and progress can be used to generate individual “playlists” of customized learning activities, such as Carnegie Mellon University’s Open Learning Initiative.

Embracing speedy development of and testing of new assessments. A new assessment can be field-tested by placing it into a Web-based learning environment. Crowdsourcing student responses can provide data points to quickly improve features of the assessment before its large-scale use.

Enabling broader involvement in providing feedback. Learning is no longer contained within the classroom. Online communities allow learners to tap into a broader network of subject-matter experts, encouraging lifelong learning. Feedback from nontraditional educators such as parents and other learners strengthens procedural knowledge while encouraging collaboration.

Reducing test taking for the sake of accountability. When teaching and learning are mediated through technology, educators can reduce the number of external assessments. Countless data streams captured by online learning systems provide information needed to judge a learner’s competencies. This information can then be aggregated to draw insights at a school and a national level.

One example of technology-enabled assessment is Group Scribbles, a Singapore-based educational technology platform. This captures complex student responses to support peer instruction and continuous assessment. Students can contribute to a classroom discussion by using a tablet or handheld computer to add notes and sketches to an electronic whiteboard. They then learn by explaining their work to others and providing and receiving feedback, which helps develop foundational literacies, competencies, and character qualities.

Leeruniek, a Dutch learning analytics platform, also focuses on improving personalized education by providing insight in students’ progress across subjects. It aggregates multiple data streams (test scores, educational games, daily exercises, or data on social-emotional development) and turns this data into practical insights for primary school educators.

There are also possibilities for universities to tap into new sources of assessment data. Start-ups such as Canada’s online student community UniversityHub have been experimenting in this area, ramping up connections between students with peers, schools, jobs, and brands. Rich sources of data, student-focused sites such as these can serve up big data analytics on students’ academic and extracurricular activities far beyond traditional résumés, applications, and interviews. UniversityHub can capture a comprehensive blueprint of a student’s past and future—from extracurricular information to brand affiliations—which can grow to become a trusted source of information for university admissions departments worldwide.
Enabling values and character development

In general, the application of technology to education has been relatively narrow, focused on disseminating curriculum efficiently as opposed to inculcating values and character or other broader skills and competencies. One interesting use of technology to develop empathy is Simorga, a social impact start-up that is harnessing the transformative power of virtual reality to tackle social issues.18 “I believe the absence of empathy in places with empathy fatigue, like hospitals, or empathy challenges, like prisons, is at the core of many problems humanity faces,” said founder and CEO Alexandra Ivanovitch. “Virtual reality helps us see the world through the eyes of other individuals to widen our scope of analysis, building our empathy as if a muscle.”

Pioneering evidence-based studies in cyberpsychology and cognitive neuroscience show that emergent technologies such as virtual reality, augmented reality, and artificial intelligence can enhance empathy in a variety of lab contexts and will revolutionize the way humans interact with one another.

Accelerating technology adoption and its challenges

Overall, the pace and scale of adoption of these technologies is influenced by policy and how fast the model of education can adapt, available funding, and several broader short- and long-term trends (see figure 9).

Although technology brings exciting opportunities, local and systemic challenges should be addressed.19 For example, instilling a school–work–life balance is crucial as technology becomes more accessible and integrated: there is a risk that both teachers and students rely

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**Figure 9**

*Several trends are driving the use of education technology*

<table>
<thead>
<tr>
<th>Fast-moving: one year or less</th>
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<tbody>
<tr>
<td>- <strong>Normalization of digital delivery</strong>: for example, the growing availability of free content</td>
</tr>
<tr>
<td>- <strong>Ubiquity of social media</strong>: changes in sharing knowledge and collaborating</td>
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<tr>
<td>- <strong>Rethinking the roles of teachers</strong>: guides and mentors to promote independent and active learning</td>
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</tbody>
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<th>Mid-range: three to five years</th>
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<tr>
<td>- <strong>Growing use of hybrid learning designs</strong>: better engagement and personalization</td>
</tr>
<tr>
<td>- <strong>Rise of data-driven learning and assessment</strong>: analytics to enable continuous improvement of learning outcomes</td>
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<tr>
<td>- <strong>Shift from students as consumers to students as creators</strong>: creativity as the means for hands-on learning</td>
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<tr>
<th>Long-range: five or more years</th>
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<tr>
<td>- <strong>Reinvention of the personal computer</strong>: evolving design and relevance amid smart devices and cloud computing</td>
</tr>
<tr>
<td>- <strong>Rethinking of how schools work</strong>: more flexible schedules to allow opportunities for authentic learning to take place and ample room for independent study</td>
</tr>
<tr>
<td>- <strong>Shift to deeper learning approaches</strong>: student-centered active learning approaches such as problem- and challenge-based learning enabling learners to be more engaged in the subject</td>
</tr>
</tbody>
</table>

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18 *Expanding Empathy to Accelerate the Advancement of Humanity*, XPRIZE
19 2014 *New Media Consortium Technology Outlook – International Schools in Asia: A Horizon Project Regional Report*
too much on devices and online tools and are not maximizing their productivity. Also, policies that govern schools need to keep pace as students have more diversity and autonomy in learning and as the forms of assessment or measures of success and knowledge rapidly evolve. Finally, integrating technology also raises concerns about privacy, which needs to be managed alongside incentives to encourage schools, educators, students, and parents to share data.

Funding: More Actors Are Playing a Role

New K–20 funding models are emerging beyond the traditional use of taxpayer funds. More actors are playing vital roles in these emerging models, particularly where government investment in education is relatively low.

The first emerging model is a partnership between independent institutions, such as private schools and charter schools, and industry partners for funding support and curriculum development. In Chicago, the Sarah E. Goode STEM Academy focuses on developing skills that will guarantee graduating students a $40,000 job with IBM, the school’s corporate sponsor. Many companies are also taking matters into their own hands and developing significant internal educational capabilities. For example, General Electric (GE)’s Crotonville “university” is its global leadership institute dedicated to sharing ideas and creating transformative learning experiences for customers and employees across the globe. Over the years, this has become a strategic advantage in acquiring, developing, and retaining GE’s leaders globally.20

Funding for educational institutions has become more complex and subject to geopolitical considerations.

Private-equity investment funds are also getting more involved in education. For example, India-based Kaizen Private Equity is the nation’s first fund focused entirely on education ventures. However, impact investors—funds focused primarily on social enterprise investments—have an extensive history in managing a portfolio of education businesses. Acumen Fund is a non-profit impact investment fund with five education businesses in its portfolio. Lok Capital is another example of an impact investor, focused on education and other social causes in India. Both Acumen and Lok have invested in India’s Podar International Schools, which offer standardized educational services with lean facilities, creating a low-cost solution that is self-sustainable and return-generating for its investors. Pearson’s Affordable Learning Fund is also investing in low-cost, for-profit schools. Its first investment, Omega Schools in Ghana, has already grown from 10 schools serving 6,000 students to more than 35 schools serving 20,000 students.

The third model is a collaboration between government bodies and organizations, both for-profit and not-for-profit. In Singapore, Playeum, the Children’s Centre for Creativity and Culture, has joined forces with the government to bring play-based education to underprivileged members of society. In New York, the Institute of Play launched its first project to design and implement an innovative New York City public school called Quest to Learn. Governments often

20  The Future of Leadership, GE Crotonville
find economic and capability challenges in educating social niches, particularly in rural and underserved markets, or in addressing nontraditional forms of learning, such as gaming.

The fourth model is **crowdfunding**. The best example to date is DonorChoose.org, which was founded by Charles Best, a former New York high school teacher and an Ashoka Fellow. The model is simple: schools post projects, and supporters can choose to help fund the project. The nonprofit organization has proven to be very successful, raising more than $430 million to date and reaching almost 19 million students across the United States, backing more than 700,000 projects.

Finally, funding for educational institutions has become more complex and subject to geopolitical considerations. For instance, almost 30 percent of the income at UK universities comes from the European Union.\(^2\) This raises the question of what recourse universities will have in light of Brexit. Will they significantly raise student charges, or will the UK government step in to fill the gap?

Primary and secondary education are more dependent on external funding than universities are. For example, Harvard and Yale have rich endowment funds that minimize their risks.

### The Education Ecosystem

Education is changing as the curriculum shifts toward right-brained and technological learning outcomes. New measurement standards are gaining traction around the world. Technology is being used in both privileged urban schools in developed markets and underprivileged rural schools in emerging markets, and more actors are financing education. What used to be a slow-moving, predictable sector is quickly becoming fast-paced, innovative, and complex.

However, this added complexity makes it difficult for stakeholders—particularly those relatively established in education—to know where they stand, how they are affected, how to navigate the sector, and how to stay relevant.

> “Education is the most powerful weapon you can use to change the world.”
> —Nelson Mandela

Shaping the education agenda is no longer limited to policy makers and educators. To remain relevant, the transformation must be led by continuous engagement and dialogue among policy makers, educators and students, technology and content providers, organizations, and employers. Forward-thinking stakeholders have their eye on how the sector will unfold and which strategies will create a long-term competitive advantage.

**Technology companies**, such as Google and Apple, are aware of the technology tipping point happening in education. Hardware, for example, has become much more affordable. Google is selling devices in schools, saying its Chromebooks can achieve savings of more than $5,200 per device over three years. Apple, which has been distributing its products to educational institutions for decades, has tens of thousands of MacBooks and iPads in schools around the world.
world. However, schools are not usually technology savvy and are often budget-constrained. Technology providers must offer a full suite of products and services—including managed infrastructure services, data security, and access permissions—so schools can focus on what they do best: teaching.

Similarly, software such as educational gamification and digital textbooks has become functionally rich enough for teachers and students to prefer it over traditional textbooks. Google Play for Education is a good example. This app store gives teachers access to approved apps that help them meet both curriculum requirements and students’ individual needs. However, as experts in serving adults, technology leaders will need to customize their products and services to meet the unique needs of diverse education consumers ranging from age four to the late teens. Digital control mechanisms are also needed to filter out low-quality applications, support sharing and collaboration, and ensure students are downloading only school-sanctioned materials. Those that take advantage of data tracking and analytics—in collaboration with schools and districts—will be able to identify consumer trends and behaviors early on and adapt accordingly.

**Content providers** have massive opportunities ahead to disrupt the traditional education market, similar to the impact digital had on the traditional media industry. Paper-based publishers are downsizing because of falling profits but at the same time are being forced to innovate—with fewer resources—to compete with digital and technology companies. As the media sector has demonstrated, people want information in a variety of formats: some want only digital, some want only paper, and some want varying degrees of both. Forward-thinking content providers will learn from their customers: the students themselves and the teaching environment. For students, content providers can use the growing prominence of big data in education to segment learning styles, identify the learning and results, and understand how these will shift over time. For the teaching environment, they will need to balance the urge to beta test new forms of content delivery with soliciting educator feedback about what works in the classroom. An understanding of these diverse perspectives will be crucial to adapting content strategies. However, unlike the media industry, education often doesn’t let students choose their consumption platform, nor does it allow educators to choose a delivery model. Content providers will have to educate decision makers about student preferences so the decisions benefit all K–20 stakeholders.

**Investors** will see new market opportunities open up. Between 1995 and 2011, the education sector made up a mere 1 percent of all venture capital deals. In comparison, technology accounted for 38 percent and healthcare 19 percent. Whether it is an education technology start-up or for-profit schools, this 1 percent will become a much larger piece of the pie over the next five to 10 years. Investment funds such as India-based Kaizen and US-based Novak Biddle have already become experts in this nascent industry with key equity holdings and strategic relationships across the country. Investors with education holdings will need to optimize their existing education portfolio, build expertise in a subsector, and collaborate with other holdings both within education and externally, such as ICT, to create synergies across the group.

New investors in education will need to identify niche but scalable opportunities that aren’t overvalued by a herd mentality. Coursera, for example, received $63 million in funding in 2013 and another $60 million in 2015. It has higher education courses reach millions of students across the globe, yet with an estimated burn rate of $10 million annually and an unclear monetization strategy, potential investors should consider other options with less risk, a better portfolio fit, and stronger short-term return-generating potential.

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22 Coursera company overview, Crunchbase
Teachers and administrators are the first to understand how challenging it is to achieve change in their schools, let alone implement it consistently and across an entire district, state, and country. But transformative change—the type that schools will need for the conceptual age—rarely happens top down in education: it happens from the bottom up, through teachers. The challenge they will face is grasping new technologies, learning new methods, and testing new approaches. But if we start training young teachers who understand and appreciate technology, while at the same time collaborating with universities to ensure these materials are embedded into teacher education programs, this change will occur naturally and across the board.

The challenge is much more difficult for school administrators. Because schools are being run more like businesses, school business models will start to incorporate commercial best practices to help improve operational efficiency and the student experience. Should we insource or outsource back-office functions, student administration, and career services? Should our IT infrastructure, student data, and customer relationship management solutions be onsite or offsite? Should our sales channels be digital, traditional, or a mix of both? These are all new questions for school leaders—and ones that will have unique responses depending on the location, student demographic, budget, and organizational mission.

Government bodies face three issues. The first is testing. As mentioned, PISA is a one-dimensional view of a country’s global competitiveness through education. New assessments such as ICIL must be quickly adopted to measure the other dimensions. The accreditation process also needs to change. In its current form, the process is unclear, political, and insufficiently flexible for new, innovative educational models. If it fails to improve, alternative forms of accreditation, such as Mozilla’s Open Badges, will take over. Finally, governments should embrace new delivery models, particularly public-private partnerships (PPPs). However, many governments are not prepared to collaborate with the private sector, leaving many PPPs poorly designed and even more poorly implemented. Understanding the various types of PPP models and how to set regulations and design policies around them will be vital.

Lastly, we see the need for a new role: an aggregator to help countries consolidate the delivery of education policy by coordinating change from the top down. This intermediary role may be occupied by one of the actors already identified in the ecosystem—a government ministry of education, for example—or a new type of actor, such as a newly created PPP. Regardless of the organizational model, the role would ensure that policy-level changes can be easily implemented rather than having thousands of subcritical units (regional governments, districts, and schools) trying to reinvent the change themselves. In most countries, education is a fragmented landscape with multiple states and tens of thousands of school districts that are each experimenting and doing things differently. Without an aggregator, change will be implemented from the bottom up, taking far too long and resulting in many different outcomes. However, with an aggregator, the system can not only embrace change, but also self-iterate—meaning we can incorporate changes into the system in real time as the requirements for education change in the world around us.

Employers need to acknowledge they can no longer rely on the current educational system to produce employees with the right skills. They must take an active part in the education revolution. Today’s system is not creating job-ready employees, and a college education has become an expensive check box for human resources. “We learn, and after this, we do,” said David Edwards, a Harvard professor. “We go to school, and then we go to work.” However, today’s employers need employees who can learn how to discover in order to be able to face complex and unprecedented challenges of the 21st century.

23 American Schools Are Training Kids for a World That Doesn’t Exist, Wired, 17 October 2014
Employers will need to get involved—for example, by helping educators build programs that encourage the right skills, developing mentorship programs, hiring high school students for projects in the office, letting them use real tools. Company leaders and hiring managers have a stake in addressing this issue and undertaking various initiatives.

Some have already started in this direction, anticipating upcoming changes. For example, in South Carolina, BMW gave Clemson University $10 million as far back as 2006. The automotive giant then in large part created the curriculum for an automotive graduate engineering school, drew up profiles of its ideal students, gave Clemson a list of professors and specialists to interview, and even had approval rights over the school’s architectural look.24

Cisco set up the Cisco Networking Academy to deliver a consistent curriculum to students at high schools, community colleges, universities, and other institutions in 170 countries.25 Partnerships with local businesses help students gain real-world work experience and professional connections that lead to jobs and lifelong careers. Some graduates pursue successful ICT careers in a wide range of industries. Others harness the entrepreneurial spirit and knowledge they acquired in Networking Academy to start their own businesses and create new jobs.

Following the same dynamics, Siemens has launched a four-year “earn and learn” program for apprentices at its wind turbine factory in Charlotte, North Carolina. Apprentices graduate with a degree in mechatronics from a local community college with a certification from the local department of labor and no student debt.26 Also, European aviation leader Airbus boasts partnerships with 21 universities in 11 countries training more than 120,000 “engineers of the future.”27 However, these separate initiatives need to be scaled up at an industry and business level.

The Way Forward

Education is a thousand-year-old industry on the cusp of profound change. Now is the time to jointly design an ecosystem that can take us into the next hundred years.

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24 BMW’s Custom-Made University, The New York Times, 29 August 2006
25 Networking Academy: Preparing the Workforce of the Future, Cisco
27 Commitment to Education: Inspiring the Next Generation, Airbus Group
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Ashoka is the world’s largest network of social entrepreneurs and institutional change leaders. With more than 3,500 social entrepreneurs, 200 schools, and 40 universities in more than 85 countries, the global organization developed and led the movement of social entrepreneurship and ultimately tipped this movement into the mainstream. Social entrepreneurship is now widely recognized as a distinct field with enormous potential for both businesses and society. Ashoka’s work proves that the surest way to create lasting change in any area, as well as preparedness to thrive in today’s rapidly changing world, is to create a society of problem solvers by equipping everyone to act as an agent of change.