

| PART ONE |

WHAT IS 21ST CENTURY LEARNING?

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Learning Past and Future

We are currently preparing students for jobs that don't yet exist . . . using technologies that haven't yet been invented . . . in order to solve problems we don't even know are problems yet.

—Richard Riley, Secretary of Education under Clinton

It happened quietly, without fanfare or fireworks.

In 1991, the total money spent on Industrial Age goods in the United States—things like engines and machines for agriculture, mining, construction, manufacturing, transportation, energy production, and so on—was exceeded for the first time in history by the amount spent on information and communications technologies: computers, servers, printers, software, phones, networking devices and systems, and the like.

The score? In 1991, “Knowledge Age” expenditures exceeded Industrial Age spending by \$5 billion (\$112 billion versus \$107 billion). That year marked year one of a new age of information, knowledge, and innovation.¹ Since then, countries around the globe have increasingly been spending more on making, manipulating, managing, and moving bits and bytes of information than on handling the material world's atoms and molecules.

This monumental shift from Industrial Age production to that of the Knowledge Age economy—information-driven, globally networked—is as world-changing and life-altering as the shift from the Agrarian to the Industrial Age three hundred and fifty years ago.

Moving from a primarily nuts-and-bolts factory and manufacturing economy to one based on data, information, knowledge, and expertise has had a huge impact on the world's economies and our everyday lives. The sequence of steps to produce a product or service, the so-called value chain of work, has dramatically shifted, as shown in Figure 1.1.

Industrial economies are focused on turning natural resources such as iron and crude oil into products we use—automobiles and gasoline. Knowledge economies turn information, expertise, and technological innovations into services we need, like medical care and cell phone coverage.

This of course doesn't mean that Industrial Age work will or can go away in the Knowledge Age—manufactured products will always be needed.

It does mean that with increasing automation and the shifting of manufacturing (and its environmental impacts) to lower-wage, industrial-equipped countries such as China, India, and Brazil, industrial work in Knowledge Age countries will continue

Industrial Age Value Chain

Extraction → Manufacturing → Assembly → Marketing → Distribution →
Products (and Services)

Knowledge Age Value Chain

Data → Information → Knowledge → Expertise → Marketing →
Services (and Products)

Figure 1.1. Value Chains Then and Now.

to decline and service-based *knowledge work* will continue to grow well into the 21st century.

But that's only one of a whole bundle of big changes that have arrived at our doorstep in the early part of the 21st century. And these changes will continue to make new demands on education as the century progresses.

As Thomas Friedman vividly reported in *The World Is Flat: A Brief History of the Twenty-First Century* and in *Hot, Flat, and Crowded*, the 21st century is challenging and reshuffling the very foundations of our society in new, powerful, and often alarming ways. For example:

- The world now has a truly global financial and economic ecosystem. This highly interlinked system means that a disruption in one part of the world (such as a U.S. housing loan crisis) has dire consequences to economies everywhere.
- The growing disparity in the world between rich and poor leads to social tension, conflicts, extremism, and a less safe world for everyone.

Yet the biggest challenge to the survival of all societies is the strain we're placing on our physical environment:

- Global population has risen from 2.5 billion in 1950 to nearly 7 billion in 2009. This figure is expected to exceed 9 billion by 2050.
- Despite widespread poverty, increasing numbers of people are rising into middle-class lifestyles, which drastically increases their consumption of the earth's material and energy resources.

- Increased consumption of resources is causing climate change and other threats to the natural world and its global life-support systems.

Add up overpopulation, overconsumption, increased global competition and interdependence, melting ice caps, financial meltdowns, and wars and other threats to security, and you get quite a bumpy beginning for our new century!

But as the Chinese characters for the word *crisis* (shown in Figure 1.2) suggest, in times such as these, along with danger and despair come great opportunities for change and renewed hope.

One of education's chief roles is to prepare future workers and citizens to deal with the challenges of their times. Knowledge work—the kind of work that most people will need in the coming decades—can be done anywhere by anyone who has the expertise, a cell phone, a laptop, and an Internet connection. But to have expert knowledge workers, every country needs an education system that produces them; therefore, *education becomes the key to economic survival in the 21st century.*

To further understand what our times demand of education we must take a closer look at the changing world of 21st century work.

危机

wei ji
[danger] [opportunity]

Figure 1.2. Signs for Our Times.

Learning a Living: The Future of Work and Careers

A few years ago, four hundred hiring executives of major corporations were asked a very simple but significant question: “Are students graduating from school really ready to work?” The executives’ collective answer? Not really.²

The study clearly showed that students graduating from secondary schools, technical colleges, and universities are sorely lacking in some basic skills and a large number of applied skills:

- Oral and written communications
- Critical thinking and problem solving
- Professionalism and work ethic
- Teamwork and collaboration
- Working in diverse teams
- Applying technology
- Leadership and project management

Reports from around the world confirm that this “21st century skills gap” is costing business a great deal of money. Some estimate that well over \$200 billion a year is spent worldwide in finding and hiring scarce, highly skilled talent, and in bringing new employees up to required skill levels through costly training programs. And as budgets tighten further in tough economic times, companies need highly competent employees ready to hit the ground running without extra training and development costs.

The competitiveness and wealth of corporations and countries is completely dependent on having a well-educated workforce—as

one 2006 report called it, “Learning Is Earning.” Improving a country’s literacy rate by a small amount can have huge positive economic impacts. Education also increases the earning potential of workers—an additional year of schooling can improve a person’s lifetime wages by 10 percent or more.³

So why is education falling short in preparing students for 21st century work?

The world of Knowledge Age work requires a new mix of skills. Jobs that require routine manual and thinking skills are giving way to jobs that involve higher levels of knowledge and applied skills like expert thinking and complex communicating (see Figure 1.3).

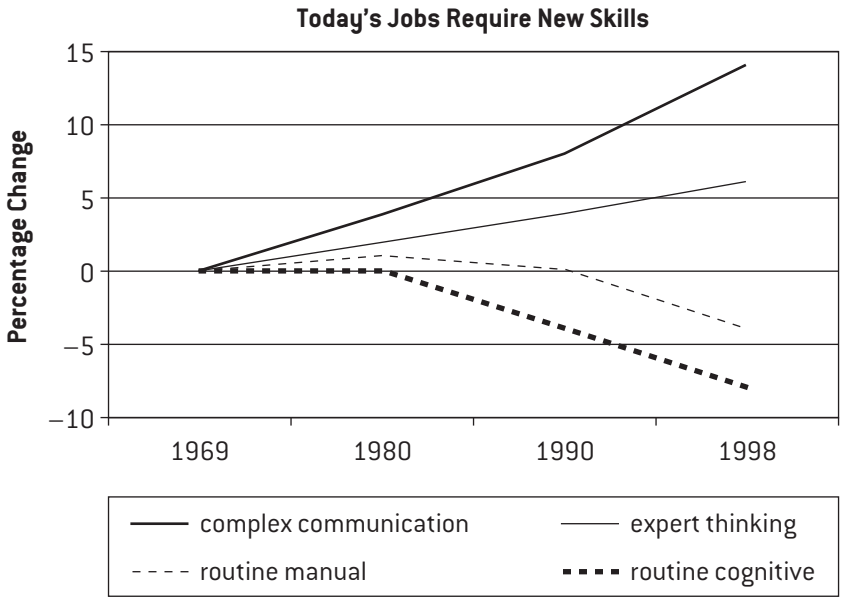


Figure 1.3. New Skills for 21st Century Work.

Source: Adapted from Levy and Murnane, 2004.

Table 1.1 lists examples of jobs requiring routine and manual skills and those with high demands for complex communicating and thinking skills.

The rising demand for a highly skilled workforce also means that there will be a growing income gap between less educated, relatively unskilled workers and highly educated, highly skilled workers. Routine tasks are increasingly being automated, and the routine jobs still done by people barely paid a living wage. Routine work is moving to countries where the cost of labor is very low, as shown in Figure 1.4.

Our world's education systems must now prepare as many students as possible for jobs at the top of the chart—the high-paying

Table 1.1. Jobs and 21st Century Work.

<i>Type of Task</i>	<i>Task Description</i>	<i>Example Occupations</i>
Routine	Rules-based Repetitive Procedural	Bookkeepers Assembly line workers
Manual	Environmental adaptability Interpersonal adaptability	Truck drivers Security guards Waiters Maids and janitors
Complex thinking and communicating	Abstract problem solving Mental flexibility	Scientists Attorneys Managers Doctors Designers Software programmers

Source: Adapted from Autor, 2007.

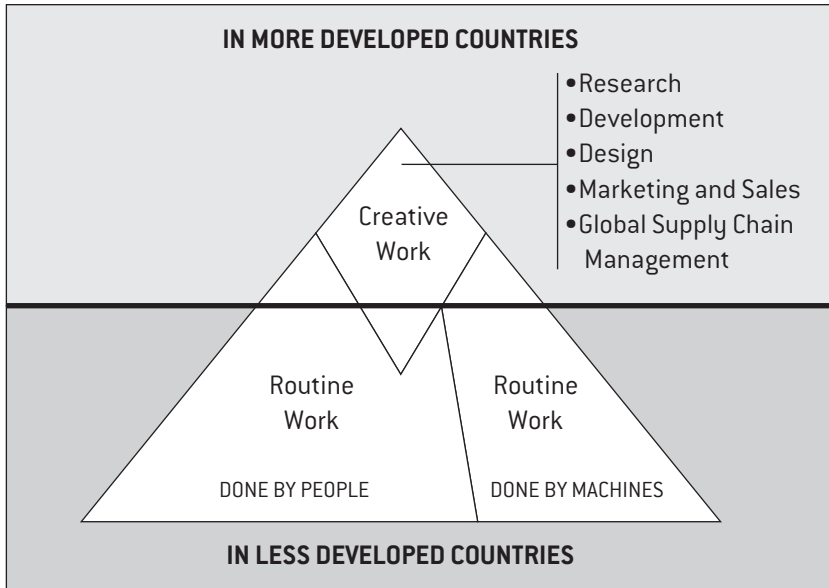


Figure 1.4. The Future of 21st Century Work.

Source: Adapted from National Center on Education and the Economy, 2007.

knowledge work jobs of today and tomorrow that require complex skills, expertise, and creativity. And many of the jobs of the future do not even exist today!

If all these changes weren't quite enough, students in school today can expect to have more than eleven different jobs between the ages of eighteen and forty-two.⁴ We don't know yet how many more job changes to expect after age forty-two, but with increasing life expectancy, the number could easily double to twenty-two or more total jobs in a lifetime!

What is certain is that two essential skill sets will remain at the top of the list of job requirements for 21st century work:

- The ability to quickly acquire and apply new knowledge
- The know-how to apply essential 21st century skills—problem solving, communication, teamwork, technology use, innovation, and the rest—to each and every project, the primary unit of 21st century work

To get a better sense of the rising importance learning and education are playing in our lives today, it's useful to step back and take a look at the roles education has played in the past, where learning is heading, and the forces driving these changes.

Learning Through Time

Currently, nearly 1.5 billion children attend primary and secondary schools in the world—around 77 percent of all school-age children.⁵

A billion and a half schoolchildren is a staggering number, even though it leaves out another three hundred million and more worldwide—most of them girls—who have no access to basic education. Still, just imagine, as the sun rises across each time zone, all those mothers and fathers waking up their children, making sure they are washed and appropriately dressed, have (hopefully) eaten some breakfast, and have gotten off to school on time—each and every day of the school year!

But why is education so important that virtually every country in the world has implemented some sort of formal education system? Why has the United Nations declared it a fundamental right of all children?⁶

And what do parents, teachers, businesses, social institutions, governments, and society as a whole expect from education? Have these expectations changed over time?

The answers to these questions can help us understand what the proper role and purpose of education ought to be in our own times.

Education's Purpose: Historical Roles and Goals

It has been observed that today's education systems operate on an agrarian calendar (summers off to allow students to work in the fields), an industrial time clock (fifty-minute classroom periods marked by bells), and a list of curriculum subjects invented in the Middle Ages (language, math, science, and the arts). It's useful to take a brief look at how this came about and what education's role has been in ages past, before turning to what education means for us now and in the future.

What do a one-room school in a rural farming village, a crowded classroom in a bustling industrial city, and a shiny new school in a high-tech suburban zone have in common? What do we expect them to do for our children? What have we expected from our schools through time?

Education plays four universal roles on society's evolving stage. It empowers us to contribute to work and society, exercise and develop our personal talents, fulfill our civic responsibilities, and carry our traditions and values forward. These are the "great expectations," the big returns we want from our investments in education. Or put another way, these are the four universal goals we expect the education of our children to achieve.

These four pillars of education's purpose remain constant through time—much like psychologist Abraham Maslow's universal "hierarchy of needs," which starts with physical needs and

moves up through safety and social needs, then respect and knowledge, and culminates in self-realization and self-transcendence.⁷

But how people go about meeting these four universal needs in different times and ages varies tremendously, as shown in Table 1.2.

In the Agrarian Age, when farming the land was the primary work of society (as it still is in many parts of the world), contributing to society meant learning how to grow food for more than your family. Passing on the knowledge, traditions, and crafts of rural life to your children was an essential survival need. Children worked in the fields next to their parents and other family members, and education beyond farming skills was not a high priority. Civic responsibilities revolved around doing what you could to help your neighbors and others in your village when they were in need, as they would in turn help you when you were in need. The social compact was simple and practical.

In the Industrial Age, when the population dramatically shifted from farm to city and work moved from the fields to the factories, education played new roles in society. Typically, men had one or two career paths: working in a trade, factory, or clerical job, or becoming a manager, administrator, or professional if they could make the grade. Women's choices were, of course, far fewer.

The real challenge for industry was to train as many factory and trade workers as possible. So standardization, uniformity, and mass production were important to both the factory and the classroom. Those few destined for managerial or professional work were given special learning opportunities to develop their potential.

Engineering and science skills, the new engines for industrial growth, were particularly prized, along with the management and financial skills necessary to keep the industrial complex running

Table 1.2. Society's Educational Goals Throughout the Ages.

<i>Goals for Education</i>	<i>Agrarian Age</i>	<i>Industrial Age</i>	<i>Knowledge Age</i>
Contribute to work and society	<p>Grow food for family and others</p> <p>Create tools and crafts for basic needs</p> <p>Participate in the local cottage economy</p>	<p>Serve society through a specialized profession knowledge work</p> <p>Apply engineering and science to contribute to industrial progress</p> <p>Contribute one piece of a long chain of production and distribution</p>	<p>Contribute to global information and</p> <p>Innovate new services to meet needs and solve problems</p> <p>Participate in the global economy</p>
Exercise and develop personal talents	<p>Learn the basic 3Rs (reading, writing, and arithmetic), if possible</p> <p>Learn farming and craft skills</p> <p>Use tools to create useful artifacts</p>	<p>Achieve basic literacy and numeracy (for as many people as possible)</p> <p>Learn factory, trade, and industry job skills (for most people)</p> <p>Learn managerial and administrative skills, engineering, and science (for a few at the top)</p>	<p>Enhance personal development with technology-powered knowledge and productivity tools</p> <p>Take advantage of expanded global opportunities for knowledge work and entrepreneurship as middle class grows</p> <p>Use knowledge tools and technology to continue learning and developing talents throughout life</p>
Fulfill civic responsibilities	<p>Help neighbors</p> <p>Contribute to local village needs</p> <p>Support essential local services and community celebrations</p>	<p>Participate in social and civic organizations to benefit the community</p> <p>Participate in organized labor and political activities</p> <p>Contribute to local and regional civic improvement through volunteering and philanthropy</p>	<p>Participate in community decision making and political activity online and in person</p> <p>Engage globally in issues through online communities and social networks</p> <p>Use communication and social networking tools to contribute time and resources to both local and global causes</p>

Table 1.2. Society's Educational Goals Throughout the Ages, *continued*

<i>Goals for Education</i>	<i>Agrarian Age</i>	<i>Industrial Age</i>	<i>Knowledge Age</i>
Carry traditions and values forward	Pass on farming knowledge and traditions to the next generation	Learn the past knowledge of a trade, craft, or profession and pass this on to the next generation	Quickly learn traditional knowledge in a field and apply its principles across other fields to create new knowledge and innovations
	Raise children in the ethnic, religious, and cultural traditions of parents and ancestors	Maintain one's own culture and values amid a diversity of traditions in urban life	Build identity from and compassion for a wide range of cultures and traditions
		Connect with other cultures and geographies as communication and transportation expand	Participate in a wide diversity of traditions and multicultural experiences Blend traditions and global citizenship into new traditions and values to pass on

smoothly. And with the great mixing of cultures in urban centers, people became more aware (and eventually more tolerant) of traditions different from their own.

Education's Role in the 21st Century

This brings us to our own time, our recently arrived Knowledge Age. In our newly flat world of connected knowledge work, global markets, tele-linked citizens, and blended cultural traditions, the 21st century demands a fresh set of responses.⁸ (See Table 1.2.) In the Knowledge Age, brainpower replaces brawnpower, and mechanical horsepower gives way to electronic hertzpower.

Achieving education's goals in our times is shaped by the increasingly powerful technologies we have for communicating, collaborating, and learning. And learning assumes a central role throughout life.

Contributing to Work and Society To be a productive contributor to society in our 21st century, you need to be able to quickly learn the core content of a field of knowledge while also mastering a broad portfolio of essential learning, innovation, technology, and career skills needed for work and life. And when you apply these skills to today's knowledge and innovation work, you are participating in a global network in which, for example, a product may be designed in California, manufactured in China, assembled in the Czech Republic, and sold in chain stores in cities across the world.

This global network of economic, technological, political, social, and ecological interconnections is no less than breathtaking. We work with the support of multiple teams spread across the world to get things done, solve problems, and create and deliver new services. But since our interlinked economies depend on both natural and human resources from around the globe, we must continually find new ways to preserve our natural world while building more harmonious, culturally rich, and creative societies.

Fulfilling Personal Talents With only 77 percent of the world's school-age children currently in school, we have a long way to go to reach universal access to a basic education. But countries are stepping up their investments in education as an economic imperative, and as a result, more students are gaining more opportunities to develop their talents.

Today nearly two billion cell phones are in use around the world, and access to the Internet is rapidly increasing in schools, homes, community centers, and Internet cafés worldwide. This is providing even more opportunities to learn and develop skills.

As amplifiers, storerooms, and sensory extensions for our thinking and communicating, digital devices and the Internet are today's power tools for building abilities and sharing talents. Making these tools universally accessible and closing the digital divide between the information rich and the information poor will provide more opportunities for learners to realize their potential. People everywhere will then be able to contribute their own special talents and gifts to the health and welfare of their community, the economy, and to society as a whole.

Fulfilling Civic Responsibilities With access to the expanded spectrum of issues, facts, opinions, and conversations that our increasingly media-rich and Internet-connected world brings us, our potential for informed participation in democratic decision making has never been better. E-mail, the Internet, and cell phones have made it easier to connect with others who share our interests and concerns and to coordinate our social, civic, and community activities.

At the same time, the potential for information overload, distraction, and analysis paralysis when facing demands for attention from too many sources—ranging from well-informed and reliable to woefully uninformed and even deliberately misleading—is also high. Learning to manage our digital power tools and to apply the critical thinking and information literacy skills needed to put all this information to good use is a clear challenge for the 21st century.

As the campaign and presidency of the world's first Internet president, Barack Obama, has shown, technology can be a powerful tool for personally engaging citizens in the political issues of our times and in the process of change. In many ways, we are just beginning to understand how to tap the enormous power of online social technologies for collaborative problem solving, political action, and community building.

Carrying Forward Traditions and Values Learning the core principles and traditions of a field of knowledge and blending these with the knowledge and practices of other fields to invent and introduce new knowledge, new services, and new products, will be a high-demand skill set in the 21st century.

Increased mobility, immigration, intermarriage, and access to job opportunities worldwide have led to another kind of blending and mixing—communities across the globe are becoming ever more culturally diverse. Though this diversity has brought vitality and richness to our communities, differences between traditional culture and modern values are still a troubling source of tension in the world.

The 21st century challenge for each of us is to build and maintain our own identity from our given traditions and from the wide variety of traditions all around us. At the same time we must all learn to apply tolerance and compassion for the different identities and values of others.

With the growing diversity of global traditions and values that now surrounds us, the challenge to maintaining social harmony is great, but the opportunities for richer, more creative, and vibrant communities are even greater.

Our historic shift to a 21st century Knowledge Age, decades in the making, has forever tilted the balance of what is needed and valued in our work, our learning, and our life. In the 21st century, lifelong learning is here to stay.

Fortunately, a number of powerful global forces are coming together to help transform learning to meet the demands of our times.

