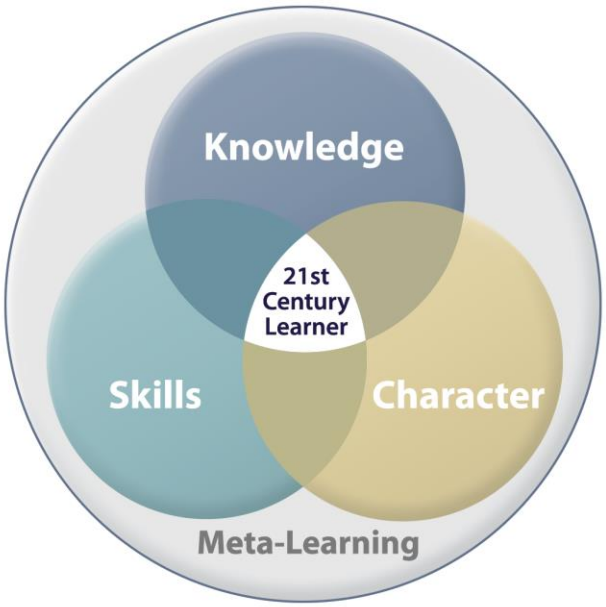
From the authors* of best-seller *21st Century Skills*

CHARLES FADEL*, MAYA BIALIK, AND BERNIE TRILLING*

Excerpt



FOUR-DIMENSIONAL EDUCATION

THE COMPETENCIES LEARNERS NEED TO SUCCEED

Prologue by **Andreas Schleicher, OECD**

"A very thoughtful treatment of the competencies our students need to thrive in today's (and tomorrow's) world. This book will help educators understand and navigate the critical choices we are facing."

-Carol Dweck, Stanford University

Praise for "Four-Dimensional Education":

"Four-Dimensional Education provides a clear and actionable, first-of-its-kind organizing framework of competencies needed for this century. Its main innovation lies in not presenting yet another one-size-fits-all list of what individuals should learn, but in crisply defining the spaces in which educators, curriculum planners, policymakers and learners can establish what should be learned, in their context and for their future."

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OECD

"Educators and policymakers worldwide owe it to students and societies to rapidly operationalize these dimensions of knowledge, skills, character, and meta-learning."

Todd Rose, Director of the Mind, Brain & Education program at the Graduate School of Education,
Harvard University

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Riel Miller, Head of Futures,
UNESCO

"*Four-dimensional education* provides a rich and practical provocation which can inspire policymakers and practitioners."

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*"Four Dimensional Educat*ion brings a deeply cogent, synthetic, open-minded conversation to explore one of the key challenges to our society – how to transform our education systems to …build the world we want."

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United States Council for International Business (USCIB)

"What should students learn in an age of search, robotics and artificial intelligence? … deep competencies, including relevant modern knowledge"

Steve Vinter, Director, Cambridge site,
Google

"A must read for anyone interested in the future of education"

Jim Spohrer, Director of University Programs,
IBM

“This book should be required reading for everyone involved in education and education reform”

John Abele,
Founding Chairman of **Boston Scientific,**
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“As scientists, humanitarians, engineers, and artists… as lifelong teachers and learners… as parents, and as humans… we owe it to our children to continuously prune our education curriculum, and to feed it with the nutrients of advancement… *Four-Dimensional Education* poses a healthy challenge to the traditional, less-relevant structures of today’s curricula.”

Kristen Wright, Director, Cisco Research & Open Innovation
Cisco Systems

"Education needs fundamental reform from top to bottom. This book puts square and centre the need for that change at every level of thinking.”

Conrad Wolfram, founder,
Wolfram Research Europe

“This book offers a wise and practical set of insights for empowering students and citizens to analyze, communicate, interact, and adapt.”

David Autor, Professor of Economics and Associate Department Head
Massachusetts Institute of Technology

“It is insightful, comprehensive, global, and coherent. It will set the compass direction for the next generation.”

Rick Miller, President
Olin College of Engineering

"*Four-Dimensional Education* establishes a framework for continuous learning that is necessary for youth and adults alike to stay relevant and to thrive in these exponential times."

Rob Nail, Associate Founder & CEO
Singularity University

"This book is an incredible resource for local educators around the world who want to put their students on a path toward shaping the future."

Wendy Kopp, CEO and Co-founder,
Teach For All

"Four-Dimensional Education offers a compelling vision for transforming education"

Matt Williams Vice President, Policy and Advocacy,
KnowledgeWorks Foundation

"Four-Dimensional Education … articulates what 21st century learners need to be successful-a must read for us all."

Dr. Helen Soule, Executive Director of P21,
The **Partnership for 21st Century Learning**

"We applaud CCR's distillation of vast research on the future of education in this accessible and compelling new book. *Four-Dimensional Education* is a MUST READ for every globally minded leader and teacher interested in advancing their institutions through innovation. Similarly, parents interested in relevant 21st century education should read this book as well!"

Heather Hoerle, Executive Director,
Secondary School Admission Test Board

"By drafting a dynamic framework for learning that adapts to and reflects success, *Four-Dimensional Education* will serve as a catalyst for lifelong learning and reinvention. The quality of our generational futures hinges on success."

David F. Clune Ph. D, President and CEO
Educational Records Bureau (ERB)

"Our current circumstances cry out for a new model of education. This book provides one and will be a powerful tool in the hands of those committed to preparing their students for the challenges of 21st century life and work."

Ken Kay and Valerie Greenhill, co-founders of **EdLeader21**
and co-authors of "The Leaders Guide to 21st Century Education: 7 Steps for Schools and Districts"

Table of Contents

Chapter 3

The Knowledge Dimension

Knowledge—Traditional and Modern

Evolving Maps of Traditional Knowledge Disciplines

Curating Traditional Disciplines for Relevance

Three Aspects of Value

Modern (Interdisciplinary) Knowledge

Human Lifespan Extension

Connected People, Organizations, and Planet

The Rise of Smart Machines and Systems

Big Data and New Media

Environmental Stresses and Demands

Amplified Humans

Themes

Information Literacy

Systems Thinking

Design Thinking

Environmental Literacy

Digital Literacy

The CCR Knowledge Framework Summarized

Chapter 4

The Skills Dimension

Knowledge and Skills Together

Skills and Eduployment Gaps

Creativity

Critical Thinking

Communication

Collaboration

Applied Learning

Chapter 1
Redesigning Education for a Transforming World

> The future ain't what it used to be.
> —Yogi Berra

Global Trends and Challenges

What can we as individuals, and collectively as a society, do to ensure that we have a positive effect on the world? The goals for a better future can widely be agreed upon: more peaceful, sustainable societies, comprised of more personally fulfilled people, making full use of their potential. These same goals can be thought of in a number of ways—high levels of civic and social engagement, personal health and well-being, employment in good quality jobs, economic productivity, ecological sustainability, and so on.

Educating our children, in theory, is meant to prepare them to fit in with the world of the future, empowering them to actively work to improve it further. Yet there is growing evidence (as we will see later) from scientific studies, from employer surveys, from widespread public opinion, and from educators themselves, that our education systems, globally, are not delivering fully on this promise—students are often not adequately prepared to succeed in today's, let alone tomorrow's, world.

One reason is that the world continues to transform dramatically, while education is not adapting quickly enough to meet all the demands these transformations are bringing. The challenges and opportunities of today are starkly different from those of the Industrial Revolution, when the first blueprint for a then-modern education system was crafted. They are even different from the challenges of just a couple of decades ago, before the Internet. The world's new, electronic hyper-connectedness poses an entirely new breed and scale of potential problems.

We can see these new problems in recent events such as the 2008 global economic recession. In the past, when a small number of banks in one country may have had difficulties, each had to suffer the consequences alone; now, when one part of a system

fails, the negative consequences propagate throughout our interwoven economic systems, causing major problems worldwide. Our social systems, now connected into vast, global communication ecosystems, are more vulnerable to widespread global disruptions; they have grown large and fragile.[1] On top of that, we are struggling to reconcile our hopes and expectations of economic growth with overpopulation, overconsumption, and their consequences on our climate and resources.

The World Economic Forum recently brought together experts in economics, geopolitics, sociology, technology, and environmental sciences, and from business, academia, NGOs, and governments, to compile a list of the most pressing world trends and challenges. They graphed the interconnections between these various trends, highlighting important connections, such as the links between rising income disparity and dramatic increases in the risks from social instability, as shown in Figure 1.1.[2]

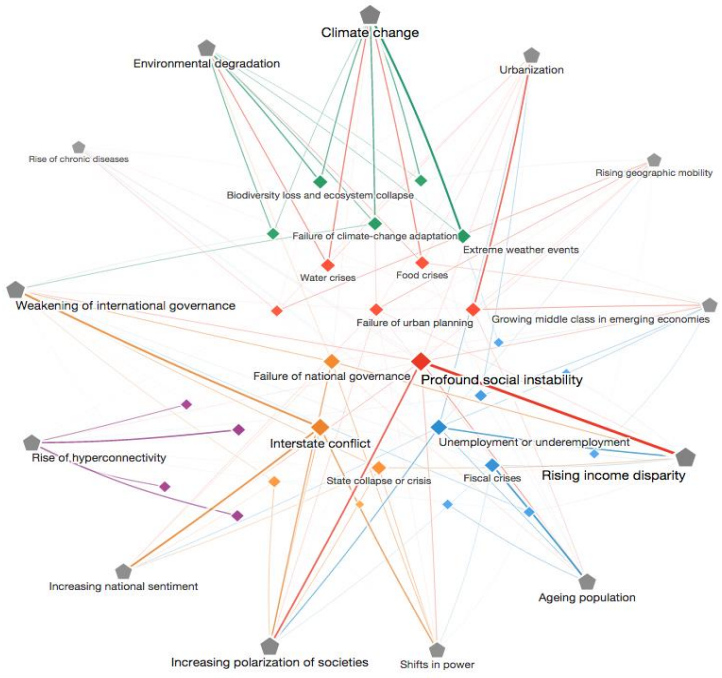

Figure 1.1 Global Trends and Risks
Source: World Education Forum

[1] N. N. Taleb, , *Antifragile: Things That Gain from Disorder* Vol. 3 (New York: Random House 2012).

[2] More on their methods here: http://reports.weforum.org/global-risks-2015/appendix-b-the-global-risks-perception-survey-2014-and-methodology/

Note: This graphic highlights the interaction of global trends (grey pentagons)[3], and risks (colored diamonds—economic risks are blue, environmental risks green, geopolitical risks orange, societal risks red, and technological risks purple). The size of each diamond node corresponds to the degree of impact and likelihood of that risk.

These trends and risks are not ones we could have predicted 50 years ago, and they will continue to interact and evolve in unexpected and unpredictable ways. Meanwhile students continue to study the same curriculum, not prepared to face the challenges in our world.

Sustainability

The magnitude of the change of scale in human impacts is a relatively new development. Our global human population has, historically speaking, only recently exploded to an unsustainable rate.[4]

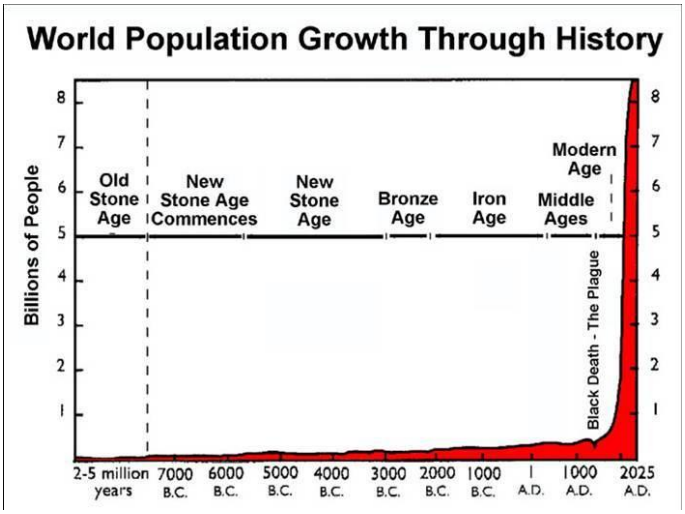

Figure 1.2 World Population Growth
Source: Population Reference Bureau

Since we are all in a globally interconnected and interdependent network of life-support systems, this population explosion has large consequences. Our societies are

[3] If you have black and white print version, please refer to the website.

[4] Elaine M. Murphy, *World Population: Toward the Next Century* (Washington, DC, Population Reference Bureau, 1994).

caught up in a web of consumption and competition patterns, and we are rapidly using up the resources we rely on to survive.

Globally, the average resources we now use in one year take the earth about 1.5 years to produce.[5] Depending on a country's lifestyle and degree of consumption, the land needed to support its level of resource use can translate into the number of earths we would need to support all of humanity, if everyone on the planet consumed resources at the rate of that one country (as seen in Figure 1.3).[6]

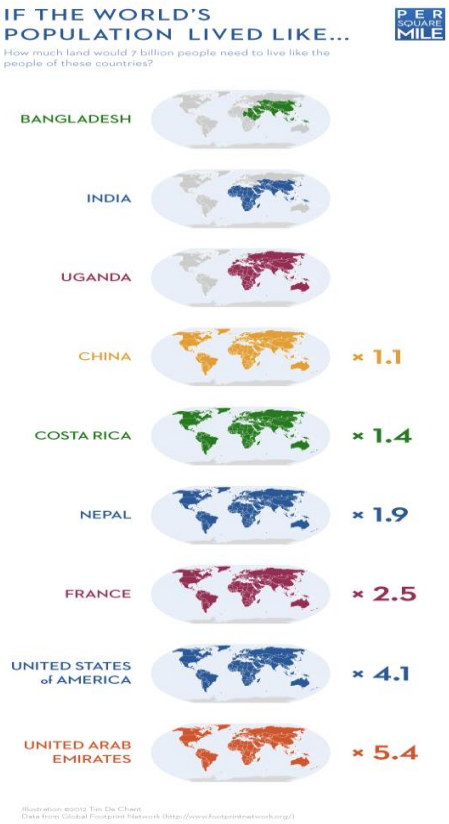

Figure 1.3 Populations and Land
Source: Global Footprint Network, http://www.footprintnetwork.org

According to a number of scientists, we have already effected environmental changes that could cause our extinction. There are many historic examples of similar collective human dead-end actions operating on smaller scales. The tribes of Easter

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[5] Global Footprint Network, http://www.footprintnetwork.org/en/index.php/GFN/page/world_footprint

[6] Christine McDonald, "How Many Earths Do We Need?" BBC News, www.bbc.com/news/magazine-33133712

Island competed with each other so fiercely (including the competitive creation of the iconic massive statues) that they used up all the available resources on the island, and their civilization collapsed.

According to evolutionary biologist Jared Diamond, the parallels between the downfall of civilization on Easter Island and today's world are "chillingly obvious." In his book, *Collapse*, he follows the arcs of several civilizations that have vanished, and shows the similarities between them and our global civilization today. Diamond writes:

> Because we are rapidly advancing along this non-sustainable course, the world's environmental problems will get resolved, in one way or another, within the lifetimes of the children and young adults alive today. The only question is whether they will become resolved in pleasant ways of our own choice, or in unpleasant ways not of our choice, such as warfare, genocide, starvation, disease epidemics, and collapses of societies.[7]

The survival of the human race depends on our ability to put our knowledge into action across disciplines and political divides. Education can be a powerful tool for survival, but the competencies to meet these challenges are currently not being taught consistently and effectively.

VUCA and Values

An acronym has emerged to describe a future that will consist of greater volatility, uncertainty, complexity, and ambiguity: VUCA. The use of the acronym VUCA began in the late 1990s in a military context. It has subsequently influenced emerging ideas on strategic leadership in a wide range of organizations, from for-profit corporations to educational institutions and governmental systems. Generally, it warns that our world is becoming increasingly difficult to predict and manage.

Our future depends, in part, on our values. Consumerism and materialism trends, while unsustainable in the long term, are to a large extent socially and culturally determined, and therefore can change as a culture's values shift. Societal values also determine where a particular culture lies on various values continua such as antagonism and tolerance, individualism and social cohesion, and materialism and the search for

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[7] Jared Diamond, Collapse: How Societies Choose to Fail or Succeed (Penguin: New York, 2005), 498.

deeper meaning. As we begin to collectively consider alternative values that would be more globally sustainable and personally fulfilling, we are responding to both pushes, based on necessity and anxiety about the direction our current values are taking us, and pulls from the desire for better societal systems based on altered values.

Pushes	Pulls
Anxiety about the future.	Promise of security and social cohesion.
Concern that policy adjustments are insufficient to avoid crises.	Ethics of taking personal responsibility for others, nature, and the future.
Fear of loss of freedom and choice.	Engaged participation in community, political and cultural life.
Alienation from dominant culture.	Pursuit of personal meaning and purpose.
Stressful lifestyles.	Time for personal passions and stronger connections to nature.

Table 1.1 Pushes and Pulls
Source: P. Raskin, et.al., *The Great Transition: The Promise and Lure of Times Ahead* (Boston, MA: Stockholm Environment Institute, 2002).

The value systems that arise from these pushes and pulls can embrace both aspirational and inspirational goals, rather than merely adopting defensive or depressive attitudes. Being aware of the powerful forces that contribute to our modern life, we can act as agents with intention and a design mindset, and not just impulsively react to the dramatic changes around us. This agency, necessary to change the world, needs to be reflected in an effective twenty-first century education.

Exponential Progress and Future Predictions

> It's difficult to make predictions, especially about the future. —Mark Twain

For the human mind, accustomed to thinking linearly, exponential change is a difficult concept to grasp. Consider the Indian legend in which a local king challenges the god Krishna to a chess game. They decide to bet one grain of rice on the first square, and double the amount on each square thereafter. Having lost the game, the king begins to arrange the rice according to their agreement, but soon realizes he would not be able to fulfill his promise. One grain of rice is not much, and doubling doesn't seem like much either, but the growth is exponential. By the twentieth square, the King would have had to put down 1 million grains of rice, and 2 million on the next. By the last square, it would be more than one hundred quadrillion grains of rice—equivalent to more than 1000 times the current world rice production.

Computing and communication technologies grow in a similar way. For transistors in circuits there is even a special name for the observation that progress happens exponentially: Moore's Law. Moore's Law states that the density of transistors doubles every 1.5 to 2 years, with corresponding increases in computational speed and storage capacity.

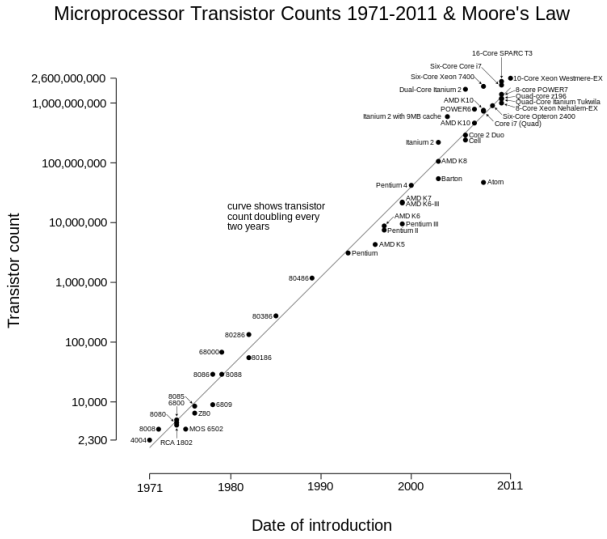

Figure 1.4 Moore's Law
Source: Wikimedia Commons, https://commons.wikimedia.org/wiki/File:Transistor_Count_and_Moore%27s_Law_-_2011.svg#/media/File:Transistor_Count_and_Moore%27s_Law_-_2011.svg.

Thus today we are experiencing a massive revolution in communication in the form of the Internet. It is the first truly global, interactive, social, communication medium that is accessible to a significant number of the world's population. Ideas, images, and sounds zip around the world at the speed of light, disrupting industries and cultures along the way. Put another way, to reach an audience of 50 million people it took radio 38

years, television 13 years, the Internet four years, and Facebook only two years. The speed of technological change today is vastly greater than it was even several years ago—innovations in technology are being adopted at exponential rates, vastly more rapid than in any prior time in civilization.

Typically, we make predictions about the future by extrapolating from the past, but this can often lead us astray. In 2004, the best-selling mobile phone was the Nokia 2600, a single-function cellular telephone. Phones were expected to get smaller and smaller, with no other significant changes. Yet only three years later, the first iPhone was introduced, and it altered the course of the design and use of mobile phones, which became smartphones. Now our "phones" are significantly larger than the old Nokia, have almost no buttons, and exist in an ecosystem of apps that relate to every aspect of life.

This would have been very difficult to predict from the trends in 2004, because the change was discontinuous with the trends. Similarly, any predictions we make now about education are bound to be partially wrong. We cannot depend on current predictions based on recent trends to carve our future educational goals, standards, and curricula in stone. Rather, we must create flexible guidelines that help prepare our students to be versatile enough to succeed no matter how our unpredictable world changes around us.

A succinct representation of versatility, transcending an employer's perspective, can be visualized via IBM's *T*-shaped individual[8]—one who is capable of both depth *and* breadth.

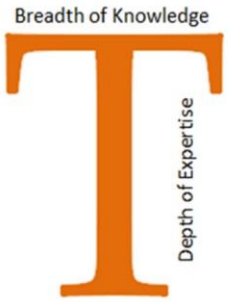

Figure 1.5 T-Shaped Individual
Source: Jim Spohrer, IBM

It is expected that over the life of an individual, several types of expertise will be developed—forming an *M*-shaped individual. Although it is extremely difficult to predict with any specificity the important technological breakthroughs of the distant future, various organizations have made well-informed attempts at predicting large-scale

[8]Jim Spohrer, *Slideshare*, www.slideshare.net/spohrer/t-shaped-people-20130628-v5

patterns of the near future. A comparison of three of these, showing how they align across general categories or themes, is shown in the following table.

KnowledgeWorks Foundation (Forecast 2020)[9]	World Future Society (Top 10 breakthroughs of the next 20–30 years)	McKinsey Global Institute (Top 12 economically disruptive technologies)[10]
Human Lifespan Increase	—	Next Generation Genomics
Connected People, Organizations & Planet	Global Internet access Virtual Education	Mobile Internet
Rise of Smart Machines & Systems	Quantum Computers Nanotechnology Smart Robots	Automation of Knowledge and Work Advanced Robotics Autonomous and Near-autonomous Vehicles 3D Printing of Parts Advanced Materials
Massive Data & New Media	Entertainment on Demand	Internet of Things Cloud Technology
Environmental Stresses & Demands	Alternative Energy Desalination of Water Precision Farming	Energy Storage Advanced Oil and Gas Exploration Renewable Energy
Amplified Humans	Biometrics	—

Table 1.2 Trend Comparisons
Source: CCR

These trends will likely have profound implications for both the relevant content students will need to learn, and the innovative ways they will be learning it in twenty-first century education systems (more on this in Chapter 3, "The Knowledge Dimension").

[9] KnowledgeWorks Foundation, Forecast 2020, as discussed in the Exponential Progress section of this chapter.

[10] James Manyika, Michael Chui, Jacques Bughin, Richard Dobbs, Peter Bisson, and Alex Marrs, Disruptive Technologies: Advances That Will Transform Life, Business, and the Global Economy ,McKinsey Global Institute (May 2013), www.mckinsey.com/insights/business_technology/disruptive_technologies

Technology's Impact on Society

> Technology gives us power, but it does not, and cannot, tell us how to use that power.
>
> —Jonathan Sacks

We have been apprehensive of technology changing society for a very long time. Socrates famously believed that writing would "create forgetfulness in the learners' souls" and thus did not record his own words and work. In a way, he was right.

Compare our memorization ability with those of people with long-standing oral traditions who could recite epic works such as the *Iliad* entirely from memory—and our modern culture seems incredibly memory deficient. For the majority of humanity's history, it was commonplace to hold entire books in one's mind, a skill that has become obsolete, and thus, no longer practiced. If Socrates time traveled to today's world, he would be appalled at how little we memorize, and how much we rely on memory aids outside of our own minds.

And yet, writing things down has given us a collective history that can be viewed and added to at any time, allowing people to build on and critique each other's work. So this concern about technology's impact is at once a very old worry about very real consequences, and a source of great hope, as technology has the potential to be empowering and world-changing.

Critics of technology's impact on society point to increasing rates of childhood obesity, face-to-face socializing being replaced by multi-user video games, addictive and withdrawal-like behaviors from excessive media use, and lower comprehension when reading from electronic sources versus paper ones. Yet many of these aspects are being addressed by new technology adaptations and new ways of using existing technologies. Games are now being intentionally developed to include face-to-face collaboration and interactions in the real world. The aspects of games that make them addictive (autonomy, mastery, and purpose) are being better understood and harnessed for more powerful learning experiences.[11] The nuances of comprehension differences in reading from differing media types are being further explored, and may be addressed by future technology innovations.

Every breakthrough has this potential for both positive and negative effects—progress is truly a double-edged sword, and technology is an amoral amplifier. For

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[11] D. H. Pink, *Drive: The Surprising Truth About What Motivates Us* (New York: Penguin, 2011).

instance, the commercialization and commoditization of knowledge on the Internet can lead to much wider access to knowledge, instant distribution, and sharing of ideas. But it can also lead to the spread of more dangerous knowledge such as 3D-printed weapons, home-grown biological warfare agents, and so on. Scientific discoveries are subject to the same duality—nuclear energy can be used as a positive, abundant energy source, or it can be used to make powerfully negative, destructive weapons.

An important point to underscore here is that we may not be able to stop the accelerating progress of invention and technology, but we can carefully manage how they are used in our lives. We need to be very explicit in what we most want out of technology, so that its negative effects will continue to be curbed and its positive potentials continue to be enhanced. We need to be highly intentional about using technology as an empowering tool for reaching our goals, not just for its appeal as a novelty or crutch.

Our education systems need to focus on the universally positive goals of building personal competencies, expertise, and wisdom for all learners. All students need to learn to consider the wider implications of their actions, to act mindfully in the world, and to reflect and adapt as the world changes.

Technology, Automation, Outsourcing and Jobs

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

Technology first removed much of the dirt, sweat, and dangers from physical work. Then it took away many of the dull mental tasks that could be automated, and now it threatens to even displace some tasks that require expert decision-making.[12] As an example, computers are being trained to diagnose breast cancer, with the potential for including many more factors than human doctors are able to consider in a given instant.[13]

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[12] For an in-depth treatment of the subject, see Erik Brynjolfsson, *The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies* (New York: W. W. Norton, 2014).

[13] Andrew Beck et al.,,"Systematic Analysis of Breast Cancer Morphology Uncovers Stromal Features Associated with Survival," *Science Translational Medicine* 3 (2011), http://med.stanford.edu/labs/vanderijn-west/documents/108ra113.full.pdf

But does this mean that humans will necessarily be squeezed out of all of their occupations? As computers are beginning to drive cars and take restaurant orders, this thought is floating to the surface of the public discussion. Or could it mean that more people will be freed up to do more meaningful work, and use more powerful tools to their advantage in their tasks? Could more people follow their passions more deeply, and have more of a positive influence on the world?

Human work and expertise comes in many different forms and flavors. Based on the variety of shifts in technology used in different countries around the world, some jobs are now being automated or performed at lower costs in other countries, and the exact needs for certain types of jobs in particular locations are disappearing and reappearing in very high demand somewhere else in the world.

The following graphs are representations of how job types have changed since 1850 in both percentages and real numbers.

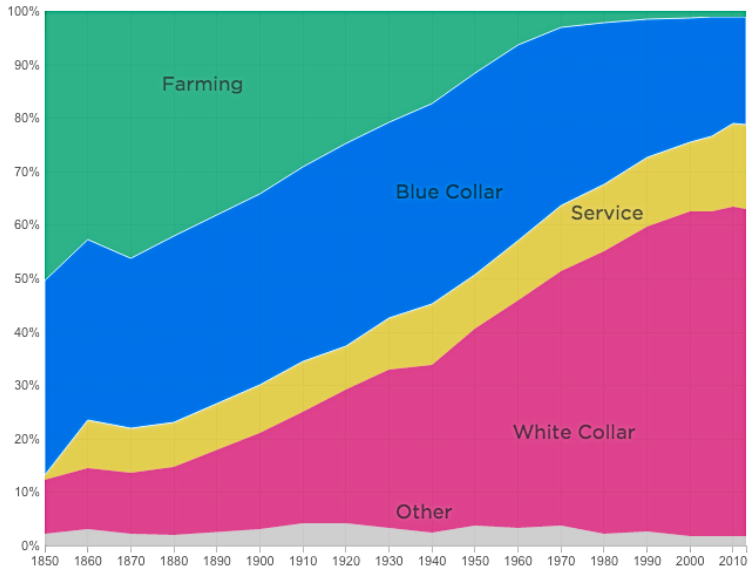

Figure 1.6 Job Types over Time in Percentages
Source: IPUMS-USA, University of Minnesota

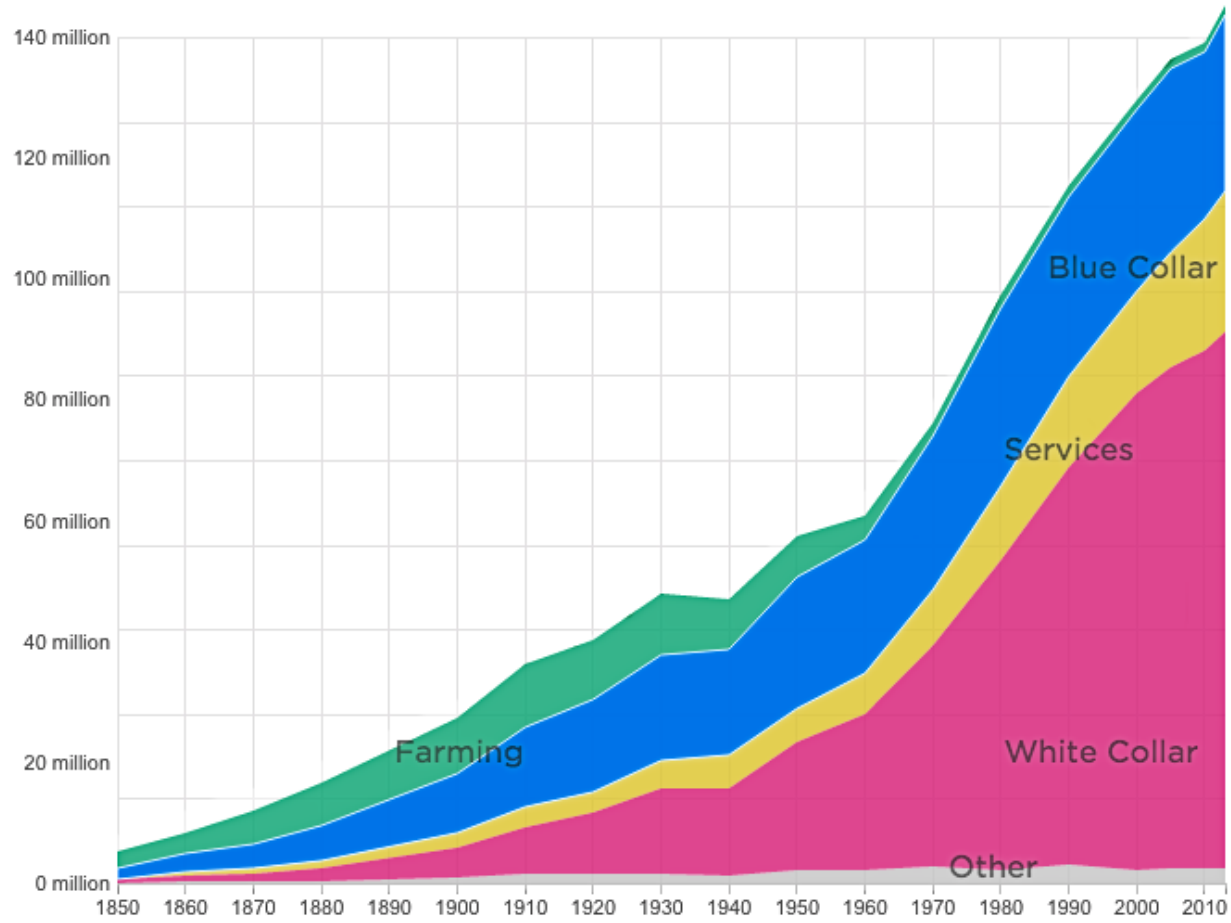

Figure 1.7 Job Types over Time in Numbers
Source: IPUMS-USA, University of Minnesota

The intuitive notion that technological progress would make jobs easier and create more leisure time is proving to be untrue. People are working just as much, if not longer and harder, and producing more and more. Even as certain types of jobs become automated, entirely new kinds of jobs appear, such as social media manager, and cloud services engineer.

Automation is not a new phenomenon. Horses were replaced by cars, medieval scribes by the Gutenberg printing press, and launderers by washing machines, cashiers by checkout barcode scanners, credit card readers, mobile phone payment chips, and so on. And recently, retailer H&M has admitted to using mannequins' bodies "with no flaws" in place of human models.

Figure 1.8 Mannequins—Only the faces are real.
Source: Le Monde Culture and Ideas, December 24, 2011

This leads us to important questions:

- What types of occupations are subject to automation and what types are not?
- More precisely, to what degree?
- What new jobs get created, and what competencies will they require?
- How do we prepare our students for the jobs that will actually exist when they graduate?

First, we must understand how automation works. Generally speaking, computers can execute a program that follows a pattern, or a set of rules. Their strengths are speed and accuracy, whereas humans' strengths are flexibility and synthesis. Below are some examples ranging from easy to difficult in terms of programming.

Increasingly Difficult to Program →

	Rules-Based Logic	Pattern Recognition	Human Work
Variety	Computer Processing using Deductive Rules	Computer Processing using Inductive Rules	Rules cannot be Articulated and/or Necessary Information cannot be Obtained
Examples	Calculate Basic Income Taxes Issuing a Boarding Pass	Speech Recognition Predicting a Mortgage Default	Writing a Convincing Legal Brief Moving Furniture into a Third Floor Apartment

Figure 1.9 Programming Difficulties
Source: Third Way, http://content.thirdway.org/publications/714/Dancing-With-Robots.pdf

We can see the effect of automation when we examine what types of jobs in the United States have increased and what types have decreased since 1960.

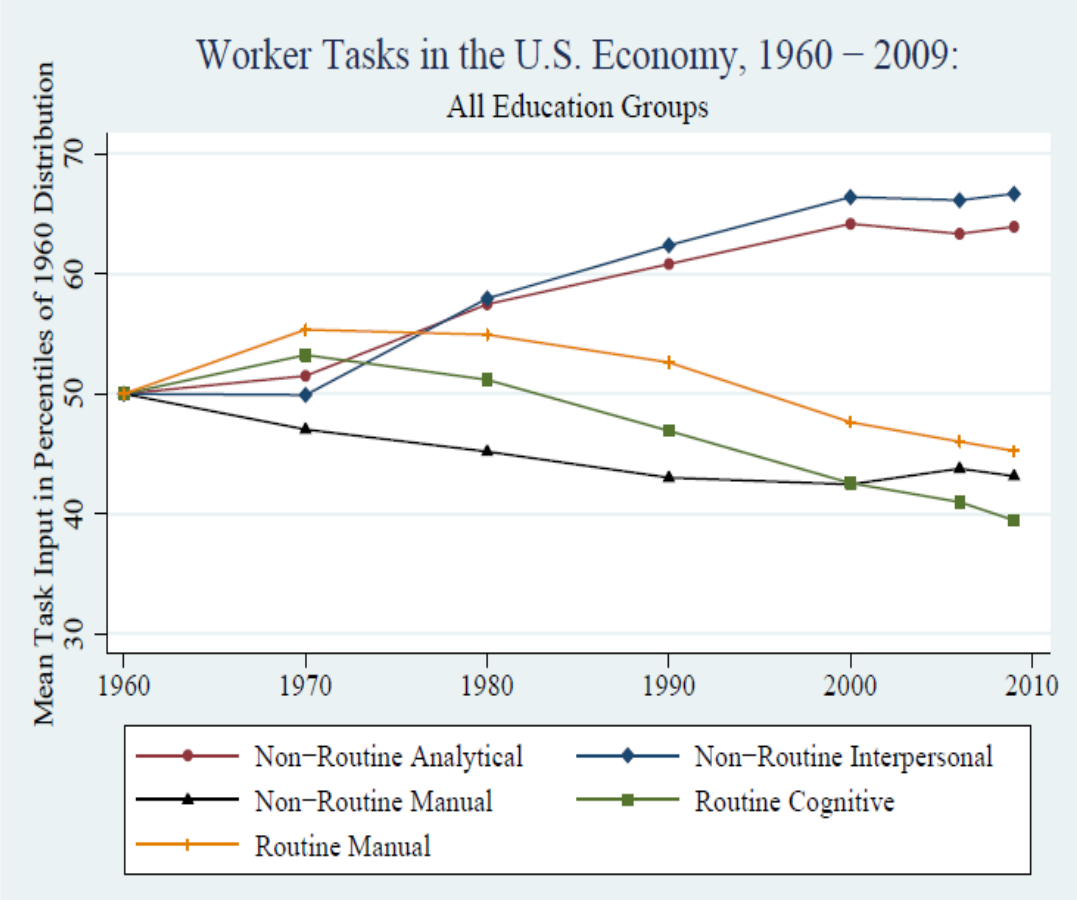

Figure 1.10 Worker Tasks
Source: D. Autor, "The Changing Task Composition of the US Labor Market: An Update of Autor, Levy, and Murnane (2003)," MIT (2013), pdf: http://economics.mit.edu/files/9758

Routine tasks, whether manual (e.g., assembly work) or cognitive (e.g., paperwork), can increasingly be automated and thus the demand for the associated skills is dropping. Non-routine manual jobs, such as plumbing, are also declining, but they can only decline so much, as we all continue to need plumbing repairs in our homes. However, with augmented reality, this may again be called into question, as a plumber residing across the world can guide a homeowner's hand (or haptic glove!).

What skills should we be teaching then? *Non-routine, interpersonal skills* (such as those involved in consulting) and *non-routine analytical skills* (such as those in

engineering design and medical surgery)—these are the kinds of skills that will be needed in the future.[14]

But there is another layer of detail here. Many skills can also be performed remotely, and as the world becomes increasingly connected, it also becomes increasingly small. If these skills can be provided remotely at a lower cost with the same quality, the local demand for them may decrease. Broadly speaking, tasks that can be completed over a large distance, impersonally, and delivered to the user electronically are easier to offshore.[15]

Combining these two insights, we begin to see a picture of the future emerging. Two main forces determine what jobs will be needed in the future—whether the main tasks require personal delivery (this limits offshore possibilities) or if the tasks are non-routine (this limits automation). The following is a representation of these forces and how different types of jobs are affected.

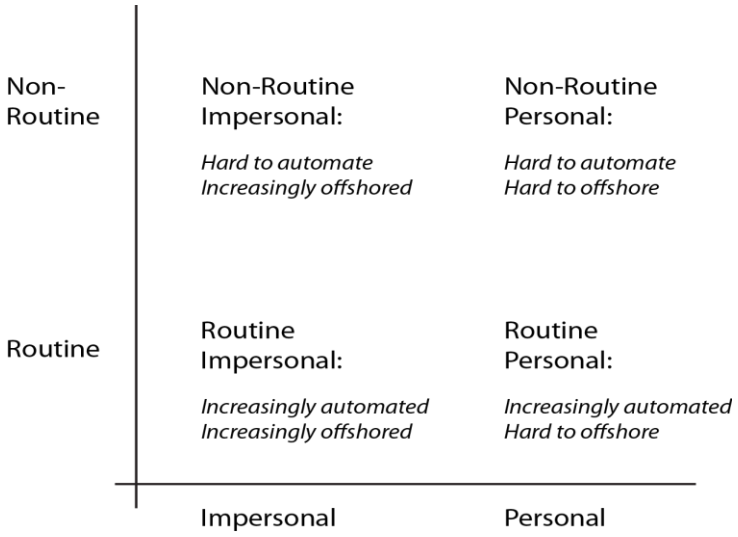

Figure 1.11 Routine and Non-Routine Jobs
Source: CCR (using Blinder for X-axis; Autor, Levy, & Murnane for the Y-axis).

[14] David Autor and Brendan Price,, "The Changing Task Composition of the US Labor Market: An Update of Autor, Levy, and Murnane (2003)," June 21, 2013, pdf: http://economics.mit.edu/files/9758

[15] Alan S. Blinder, "How Many U.S. Jobs Might Be Offshorable?" Princeton University CEPS Working Paper No. 142, March 2007.

As a general rule, this means education for employment needs to refocus away from routinized, impersonal tasks, and toward more complex, personal, creative tasks that only humans can do well. In this way, while there will be a growing need for programmers and other science and technology specialists as technology progresses, it turns out that there will also be a growing need for people who excel at creative and interpersonal tasks. These are the tasks most difficult to automate or offshore, so as computers successfully take over routine tasks, humans are left with the jobs they do best, often using computers as assistive tools to take their products to new heights, instead of being replaced by them.

This general rule may itself change as we learn how to program computers that can process huge amounts of data and make complex cognitive decisions efficiently, creating innovative designs by themselves.[16] The jobs of the future will continue to change, and we must be intentional in order to teach the competencies that continue to be relevant in the world of the future, as well as to students' fulfillment in such a world (more on this in Chapter 3: The Knowledge Dimension).

The Race Between Technology and Education

> Civilization is a race between education and catastrophe.
>
> —H. G. Wells

As technology progresses, the education necessary to utilize it effectively also grows, and education must adapt to keep up. In this way, technology and education are in a race.[17]

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[16] Such as music! See http://artsites.ucsc.edu/faculty/cope/experiments.htm

[17] C. D. Goldin and L. F Katz, *The Race between Education and Technology* (Cambridge, MA: Harvard University Press, 2009).

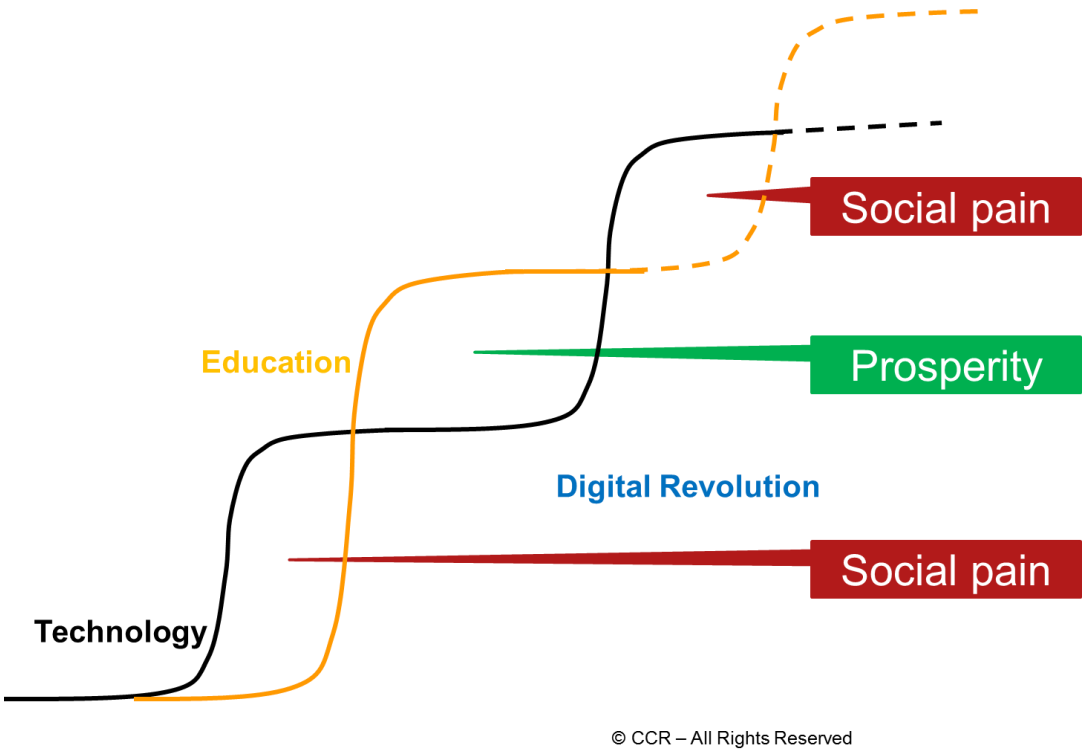

Figure 1.12 Technology and Education
Source: CCR (Inspired by *The Race between Technology and Education*.)

When education lags behind technological progress, people are not qualified for jobs and the work that does get done is likely not as productive or as high quality as it could be. Additionally, economic inequality grows, as those with the means to get an exceptional education are able to secure more opportunities for advancement, and those without the ability to afford a highly effective education have very little hope of improving their economic status. In this way, both individuals and society suffer in the form of unemployment, underemployment, income gaps, personal stress, and social unrest.

How satisfied are employers and students with the present performance of the education system? According to a study by global consultancy McKinsey, there is a large disconnect (a factor of 2!) between the (mostly satisfied) perception of education providers, and the (mostly dissatisfied) opinion of their "customers:" the youth themselves, and their employers.[18]

[18] The following are the statements that respondents were asked to agree or disagree with. For employers, "Overall, the entry-level employees we hired in the past year have been adequately prepared by their prehire education and/or training." For youth, "Overall, I think I was adequately prepared for an entry-level position in my chosen career

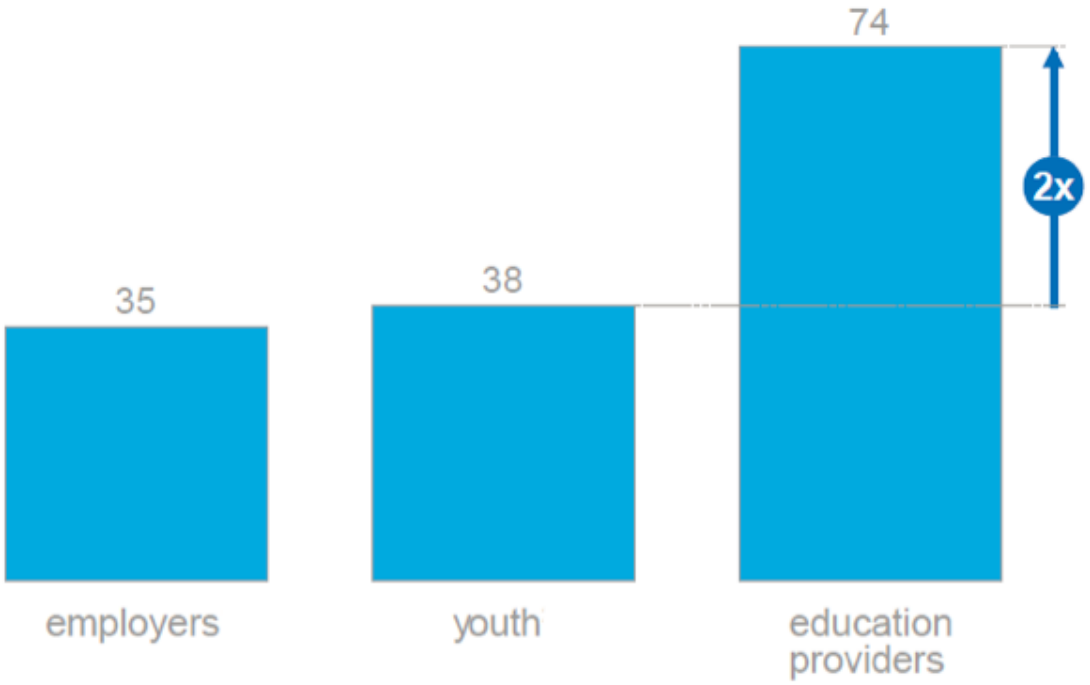

Figure 1.13. Percentage of Respondents Who Agree that Graduates/New Hires Are Adequately Prepared.
Source: "Education to Employment: Getting Europe's Youth into Work," McKinsey & Company, *January* 2014, www.mckinsey.com/insights/social_sector/converting_education_to_employment_in_europe.

So what should students learn for a world where most of the routinized and impersonal tasks are taken care of by computer systems? Is memorization of large amounts of content still needed in an age where we can find the answer to any question we may have on the Internet,?

There are many reasonable answers to these questions, but they rarely focus just on teaching *more* knowledge, rather on learning more relevant knowledge, how to apply that knowledge in new and different ways, and on developing the other three dimensions of learning: skills, character qualities, and meta-learning strategies.

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field." For education providers, "Overall, graduates from my institution are adequately prepared for entry-level positions in their chosen field of study."

Chapter 2

Education Goals for the Twenty-First Century

The Nature and Evolution of Education Goals

Individual Goals

The developmental goals for an individual are succinctly summarized by the well-known humanistic framework developed by psychologist Abraham Maslow, called Maslow's Pyramid of Needs.

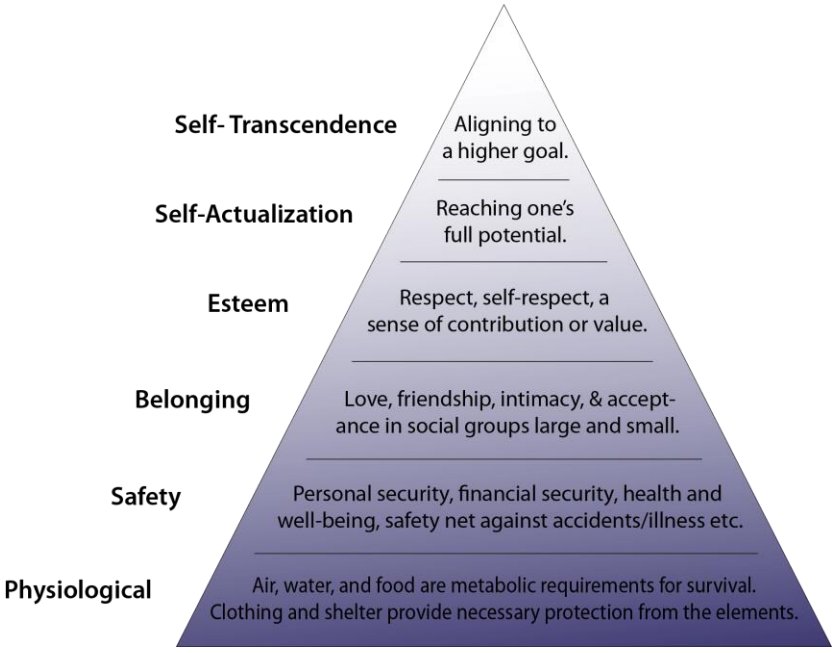

Figure 2.1 Maslow's Pyramid of Needs
Source: CCR

The shape of the pyramid highlights the idea that the lower levels are more fundamental to one's well-being, and if those are not fulfilled, the higher level needs will likely not be easily met. However, this does not mean that they are sequential. All of the levels of need are always present, are important developmental requirements, and can be fulfilled together at the same time.

At the lowest level are one's physiological needs, without which we as biological organisms will cease to function: air, water, food, and shelter from the elements. Just above that are safety and security needs, such as personal security, financial security, health, and safety. An individual who feels that these low-level needs are not being fulfilled, or are uncertain in their lives, cannot easily focus on higher-level goals. This is often the case for students living in poverty, who worry about having enough food, economic security, or have to cope with family stress or violence, and as a result have greater difficulty focusing on the demands of school and its higher need levels.

The next level in Maslow's pyramid focuses on love and belonging. As social animals, it is crucial for people to feel a sense of belonging, to have supportive friendships, a positive family dynamic, and mature, intimate relationships. Just above that is the need for esteem: to feel respected and valued by others, and to feel that one's contributions are important. If these needs are not met, an individual may experience various psychological stresses such as low self-esteem, a lack of confidence and feelings of inferiority. Psychological illnesses such as depression may prevent individuals from meeting this relational level of needs.

The highest two levels in the pyramid are self-actualization and self-transcendence. Self-actualization refers to realizing one's full potential—to do all that one can do. This can look very different for each individual depending on his or her personal goals. For example, one person may experience this need as being the perfect parent, while another may feel that it is artistic expression that fulfills their goals. Finally, self-transcendence is the need to align oneself with some higher goal outside of oneself, such as service to others or devoting time to mindful, spiritual practices.

Societal Goals

Of course, as individuals we are heavily influenced by the conditions of the society in which we live, and as active citizens and community participants, we feel an obligation to contribute to the larger goals of society as best we can, and raise our children to do the same.

Additionally, as the world is becoming increasingly interconnected, our social goals must expand to broader levels of awareness, complexity, and scale, as we now need to consider how we affect others both face-to-face and virtually. Just as Socrates viewed

"society as the soul writ large,"[19] at the scale of global humanity, our wider societal goals can be seen as parallel to the general progression of personal goals outlined in Maslow's Pyramid of Needs.

At the lower levels, it is important that the human species and the other species we depend on for our existence, all thrive. We must have the security to know that our food supply will not run out, our social systems will not collapse, and so on. At the higher levels, we strive to fulfill our collective potential – developing socially and technologically, overcoming prejudices, gathering the best possible scientific information and acting on it, and so on.

One may argue that at the highest level, the need is to achieve a species-wide feeling of relatedness and cohesion, with every individual and every group contributing their part, with the resulting chorus much greater and more harmonious than the sum of its individual voices.

In contrast, societal goals are often traditionally discussed in economic terms, related to growth and prosperity, as measured by the gross domestic product (GDP). In theory, this measure should reflect other kinds of progress as well, showing how well people are able to contribute to their societies, and how countries are becoming more successful. Yet this economic measure clearly has its limitations (such as not directly including the health of citizens or the environment as significant factors) and we are beginning to shift to measures of broader indicators such as well-being, as we realize we must not limit ourselves by what is easiest to measure, but instead focus on what matters for personal and societal fulfillment.

The OECD (Organization for Economic Co-operation and Development based in Paris) has created the Better Life Initiative,[20] an online tool in which people are invited to create their own index of well-being by prioritizing these 11 topics:

1. Community
2. Education
3. Environment
4. Civic engagement
5. Health

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[19] Plato, *Plato in Twelve Volumes*, Vols. 5 & 6, Translated by Paul Shorey (Cambridge, MA: Harvard University Press, 1969).

[20] Better Life Initiative, www.oecdbetterlifeindex.org

6. Housing
7. Income
8. Jobs
9. Life satisfaction
10. Safety
11. Work–life balance

The UN has created the Sustainable Development Goals, which define the seventeen areas for growth by 2030, with measurable outcomes (more detail on their website) [21]:

Figure 2.2 Sustainable Development Goals
Source: **@theglobalgoals (instagram)**

[21] United Nations, "Sustainable Development Goals," https://sustainabledevelopment.un.org/topics

Another set of indicators, The Social Progress Index, measures countries' performance on three dimensions: basic human needs (nutrition and medical care, water and sanitation, shelter, and personal safety), foundations of wellbeing (access to basic knowledge, access to information and communication, health and wellness, and ecosystem sustainability), and opportunity (personal rights, personal freedom and choice, tolerance and inclusion, and access to advanced education).[22]

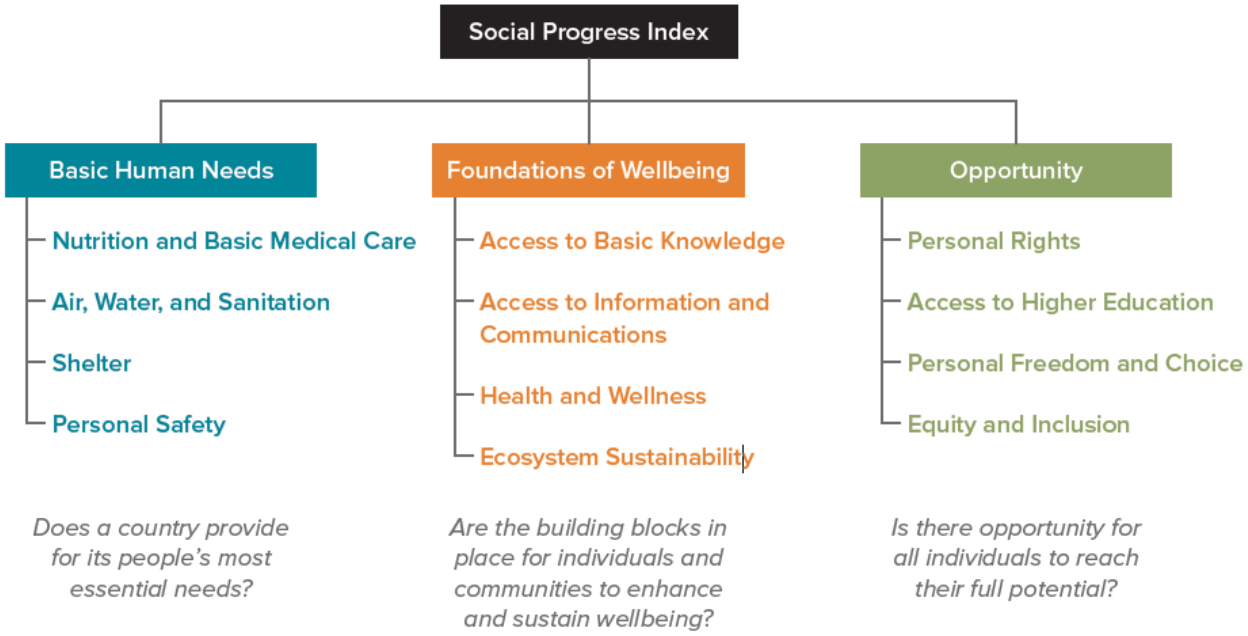

Figure 2.3 Social Progress Index
Source: www.socialprogressimperative.org

The Good Country Index measures how much each country contributes in seven areas[23] globally. Still others incorporate happiness as a distinct measure of societal success.[24] The question underlying all of these measures of the health and well-being of our societies is:

How will we learn to strive for not only economic growth but also social progress and overall well-being?

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[22] Social Progress Index, http://www.socialprogressimperative.org/data/spi/definitions

[23] Science and technology, culture, international peace and security, world order, planet and climate, prosperity and equality, and health and wellbeing. www.goodcountry.org/overall

[24] For example, Bhutan's Gross National Happiness Index, www.gnhc.gov.bt/ and the Happy Planet Index: www.happyplanetindex.org

This is a question that all twenty-first century decision makers and students will need to learn how to answer in ever-more innovative and sophisticated ways.

So, are the goals of education situated at the individual or at the societal level? This is really a false dichotomy. Consider the dynamic of the race between technology and education described in the previous section. When education lags behind technology, individuals cannot meet workforce needs, and society and individuals suffer as a result, with income inequality, productivity losses, and increased social instability. The goals of the individual are closely tied to the goals of society and vice versa.

In the ideal case, all the individuals within each society (and the global society) have their physiological, safety, belonging, esteem, self-actualization, and self-transcendence needs met, and the society itself is thriving and meeting all of its needs, with each level enhancing the others. This ideal case is in fact the overarching purpose for education in society.

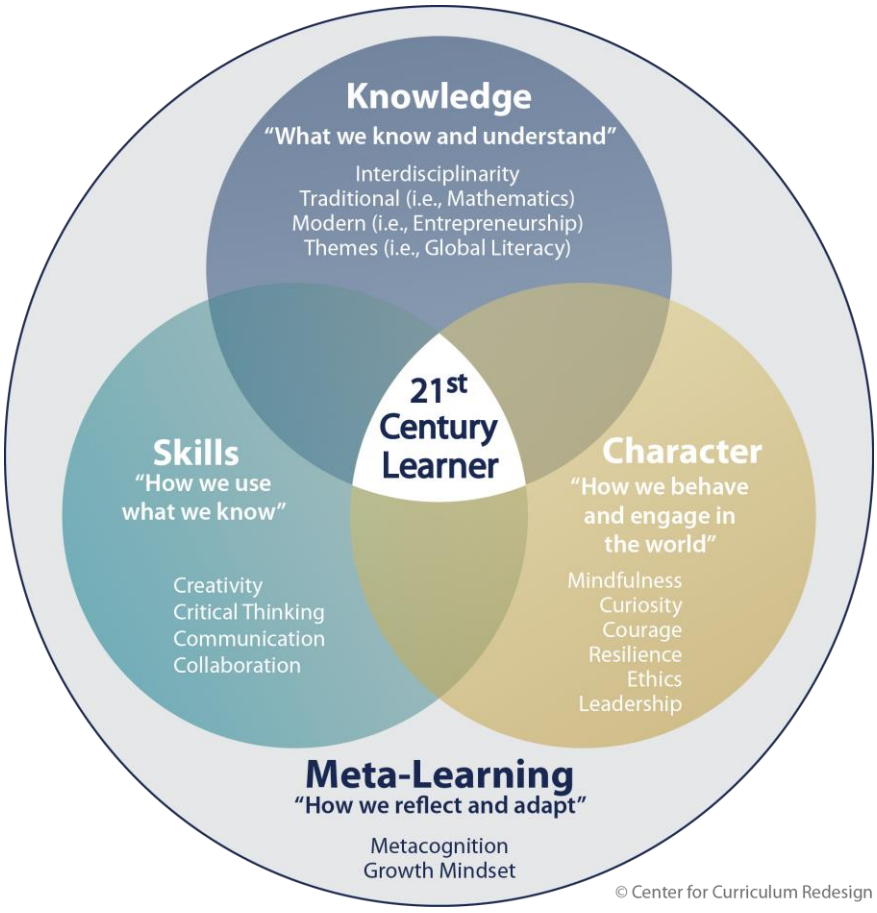

Figure 2.10 The CCR Framework

Source: CCR