less, you're less employable, yet your school doesn't refund a dime of tuition. In construction, contractors don't jump for joy if their roofers skip shingling to go gambling. In school, however, students jump for joy if their teachers cancel class to attend a conference in Vegas.

When students celebrate the absence of education, it's tempting to blame their myopia on immaturity. Tempting, but wrongheaded. Once they're in college, myopic, immature students can unilaterally skip class whenever they like. Why wait for the teacher's green light? For most students, there's an obvious answer: When you skip class, your relative performance suffers. When your teacher cancels class, *everyone* learns less, leaving your relative performance unimpaired.

Human capital purists must reject this "obvious answer." Employers reward you for your skills, not your skills compared to your classmates'. Signaling, in contrast, takes the "obvious answer" over the finish line. Why do students cheer when a teacher cancels class? Because they've escaped an hour of drudgery without hurting their GPA. Why don't students unilaterally skip class? Because if they skip class and their classmates don't, their grades suffer. Why do students focus on grades rather than learning? Because they follow the money.

Lead into Gold

If you single-mindedly focus on graduates' paychecks, education turns lead into gold. Waiters walk in; economic consultants walk out. For teachers, it's so tempting to take credit—to gaze on our former students in their mortarboards and gloat, "I amaze even myself." If teachers were honest with ourselves, we would be slower to self-congratulate. Do we really *transform* waiters into economic consultants—or merely *evaluate* whether waiters have the right stuff to be economic consultants?

By analogy, both sculptors and appraisers have the power to raise the market value of a piece of stone. The sculptor raises the market value of a piece of stone by *shaping it*. The appraiser raises the market value of a piece of stone by *judging it*. Teachers need to ask ourselves, "How much of what we do is sculpting, and how much is appraising?" And if we won't ask ourselves, our alumni need to ask for us.

CHAPTER 2

The Puzzle Is Real

The Ubiquity of Useless Education

> He rambled on about how Rembrandt captured the "soul state" of each of his figures, and then he made an analogy to Beethoven's music. He extended the analogy for several minutes not realizing that nobody in the class knew anything about Beethoven. Three weeks into summer vacation most students won't remember anything about Rembrandt.
>
> —James Schneider, "Flight into L.A."

Highlighting the stark contrast between what students have to learn and what workers need to know throws us off balance.[1] Many accept the signaling explanation and move on. Yet others recover their footing and start asking troubling questions. Could education be more useful than it seems on the surface? Less lucrative than it seems on the surface?

The signaling model solves a puzzle: Why does the labor market reward useless education? Yet perhaps we're getting ahead of ourselves. Before we solve this alleged puzzle, we must scrutinize precisely what students learn and what employers reward. Perhaps the magic of education can be dispelled.

There are several common approaches. Educators' favorite: insisting that no matter what they study, students are learning "how to learn" or "how to think." Laymen prefer stories about blood, sweat, and tears: suffering in school "teaches discipline" or "builds character." Self-made curmudgeons occasionally harrumph that anyone smart and disciplined enough to succeed in school could have done as well by skipping college and starting their own business. My father, a Ph.D. in electrical engineering, routinely denied that "soft" majors pay. When I was growing up, he gave me the impression there were only two education/career tracks. Some students study engineering to become engineers; the rest study liberal arts to become taxi drivers.

any attempts to dispel the magic of education pass muster? If so, uccessful are they? For clarity, I split the evidence into two chap- The chapter at hand focuses on learning; the chapter to follow, on ng. Can we reconcile the skills students acquire before graduation the payoffs workers enjoy after graduation? After good hard looks rning and earning, we'll know the true size of the puzzle.

Content of the Curriculum

> You obviously learn some valuable skills in school (engineering, computer science, signaling models).
>
> —David Autor, "Lecture Note 18"[2]

ery school teaches a mix of useful skills and filler, of "wheat" and haff." The crucial question is: What's today's mix? 90% wheat and 10% haff? 50/50? 20/80? While we'll never perfectly measure the break- own, the basic facts are a good place to start.

High school. What do students actually study in grades 9–12? The *Di- est of Education Statistics* shows high school grads' completed course- vork by subject. It's all "useful" in the trivial sense that it improves stu- lents' odds of high school graduation and college admission. But what bout "useful" in the stronger sense that students eventually *apply* their essons on the job? After breaking down the curriculum by subjects, I sort them into three categories of usefulness: "High," "Medium," and "Low" (see Figure 2.1).

"High" usefulness means knowledge of the subject improves job per- formance in a wide range of occupations; most students in a class will eventually use what they learn. "Medium" usefulness means knowledge of the subject improves job performance in some common occupations; a few students in a class will eventually use what they learn. "Low" use- fulness means knowledge of the subject at best improves job perfor- mance in rare occupations; students are likely to apply what they learn only if they become teachers of the subject.

These ratings are my personal judgment drawing on forty years in school. Fortunately, though, every reader has enough firsthand edu- cational experience to make an independent expert judgment. If you

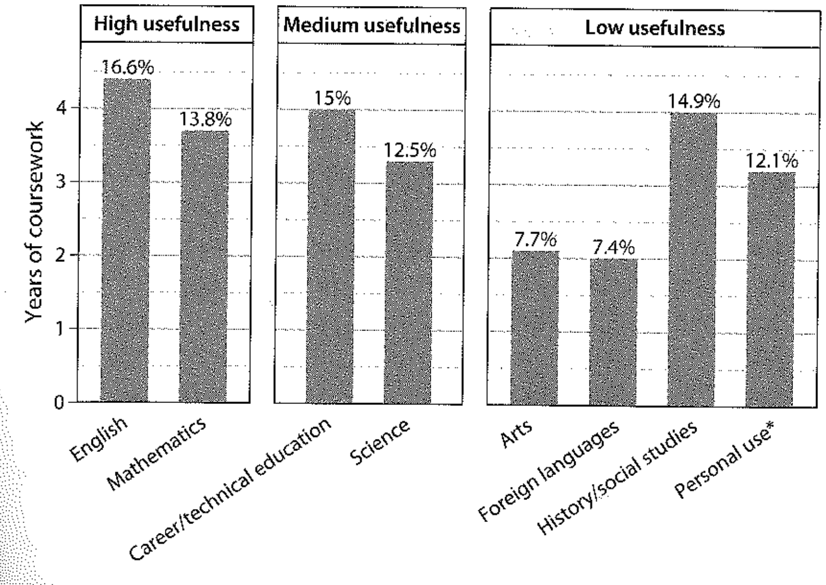

Figure 2.1: Average Years of Coursework Passed by High School Graduates (2005)
Source: Snyder and Dillow 2011, pp. 228–30, 642. "Years of coursework" is measured in Carnegie units. One Carnegie unit is 120 hours of class time over the course of a year. To get credit for a class, students need at least a D.
* Includes general skills, personal health and physical education, religion, military sciences, special education, and other courses not included in other subject fields.

question my rankings, please substitute your own. The basis for my breakdown:

High usefulness: In a modern economy, literacy and numeracy are the only skills that almost all jobs require, so English and math make the cut. Why not science? The subject is highly useful for our *society*. However, only a handful of specialists apply their knowledge of science on the job. The rest of us merely follow their recipes.

Medium usefulness: Career/technical classes are potentially useful stepping-stones for students who plan to enter a short list of trades like cooking, sewing, metalworking, woodworking, drafting, or computer programming. By themselves, though, high school–level classes do not open career doors. Students who take a class in cooking, then stop, are not yet employable as cooks. High school science classes, similarly, are only stepping-stones for the tiny share of students who pursue careers in science or engineering. How tiny? About one-third of high school graduates have a bachelor's degree; only 14% of students who earn a bachelor's degree major in science or engineering. That multiplies out to roughly 5%.[3]

Low usefulness: To belabor the obvious, the arts are rarely useful. We don't speak of "starving artists" for nothing. The staunchest fans of painting, sculpture, and music know pursuing a career in the arts is a "Hail Mary" pass. Foreign languages, similarly, are all but useless in the American economy. Thanks to immigration, employers have a built-in pool of native speakers of almost every living language.[4] The average American high school student nevertheless spends *two full years* sitting in Spanish, French, German, Italian, or even Latin. Physical education, the most recognizable form of "Personal use" coursework, trains only a handful of budding professional athletes and the next generation of gym teachers.[5] Finally, almost no one pursues a *career* in history or social studies—except teachers of history and social studies.

An optimist might emphasize that over half of students' courses are useful to some degree, and nearly one-third are highly useful. The optimist should keep in mind that I grade usefulness on a curve. Even "highly useful" subjects are more academic and less practical than they sound. Take math. Almost every modern occupation uses *some* math. Yet high schools teach and often require math rarely used outside a classroom. Figure 2.2 shows the fraction of high school grads who passed various high school math courses—and rates the courses' usefulness.

Geometry is the most common of all math courses: over four-fifths complete it in high school. Yet the subject, featuring countless proofs of triangles' congruence, is notoriously irrelevant. Geometry rarely pops up after the final exam, even in other math classes. Algebra I, which teaches students graphing and one- and two-variable equations, has many practical applications. Most students, however, continue on to Algebra II, which largely exists to prepare students for calculus.[6] Calculus, in turn, gets you into college. Once college begins, however, you'll probably never differentiate another equation unless you pursue a degree in math, science, or engineering.[7] Knowledge of statistics, in contrast, is useful whether or not you go to college. Nobel Prize winner Daniel Kahneman shows that statistical illiteracy underpins many foolish real-world choices.[8] Yet only 7.7% of high school students pass a stats class.

The point isn't that the current curricula of the American high school [illegible]lly by historic or world standards. The status quo is more practical

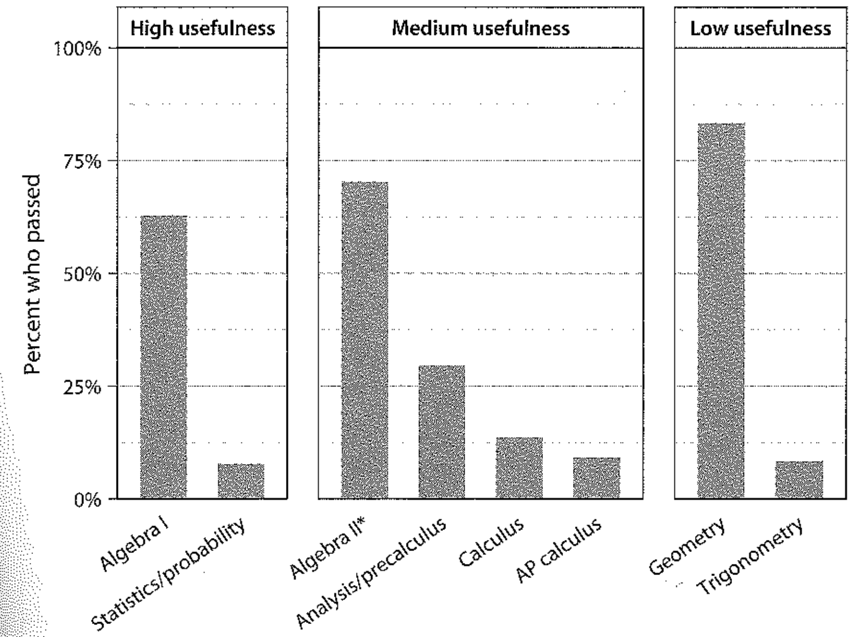

Figure 2.2: Math Coursework Passed by High School Graduates (2005)
Source: Snyder and Dillow 2011, p. 234.
* Includes Algebra/Trigonometry and Algebra/Geometry.

than a "classical education" in Latin and Greek.[9] The point, rather, is that American high school is far from the skill factory we often imagine it to be. Being more relevant than Oxford in 1750 is nothing to brag about.

College. We can ballpark the practicality of higher education by looking at the distribution of majors. Table 2.1 breaks down all bachelor's degrees conferred in 2008–9 by field of study—and rates their usefulness.

High usefulness: Defenders of the real-world relevance of education love to invoke engineering. Engineering students learn how to make stuff work; employers hire them to make stuff work. Engineering has well-defined subbranches, each with straightforward applications: electrical, mechanical, civil, nuclear. Before we get carried away, we should accept a key fact: Engineering is a challenging, hence unpopular, major. Psychologists outnumber engineers. Artists outnumber engineers. Social scientists plus historians outnumber engineers almost two to one.

What other majors deserve to be in engineering's august company? Let's grade leniently. As long as a major explicitly prepares students for well-defined technical careers, it's "highly useful." By this forgiving standard, "health professions" and agriculture majors end up in the same boat as engineers—and the fraction of graduates who earn highly useful degrees remains under 25%.

Table 2.1: Bachelor's Degrees by Field of Study (2008–9)

Field of Study	# Graduates	%
High Usefulness		
Agriculture and natural resources	24,988	1.6%
Architecture	10,119	0.6%
Biological/biomedical sciences	80,756	5.0%
Computer/information sciences	37,994	2.4%
Engineering	84,636	5.3%
Health professions	120,488	7.5%
Legal professions	3,822	0.2%
Other*	162	0.0%
Physical sciences/science technology	22,466	1.4%
Statistics/applied mathematics	1,913	0.1%
Subtotal	384,431	24.1%
Medium Usefulness		
Business	347,985	21.7%
Education	101,708	6.4%
Mathematics	13,583	0.8%
Parks/recreation/leisure/fitness studies	31,667	2.0%
Public administration	23,851	1.5%
Security/protective services	41,800	2.6%
Transportation	5,189	0.3%
Subtotal	567,696	35.3%
Low Usefulness		
Area/ethnic/cultural/gender studies	8,772	0.5%
Communications	83,109	5.2%
English	55,462	3.5%
Family/consumer sciences	21,905	1.4%
Foreign languages	21,158	1.3%
Liberal arts	47,096	2.9%
Multi/interdisciplinary studies	37,444	2.3%
Philosophy/religious studies	12,444	0.8%
Psychology	94,271	5.9%
Social sciences/history	168,500	10.5%
Theology	8,940	0.6%
Visual/performing arts	89,140	5.6%
Subtotal	648,242	40.5%
Total	1,601,368	100%

Source: Snyder and Dillow 2011, p. 412.
* Library science, military technologies, and precision production.

Medium usefulness: Majors like business, education, and public administration sound vaguely vocational and funnel students toward predictable occupations after graduation. At the same time, they teach few technical skills, and nonmajors readily compete for the same jobs. While you could dismiss these majors as Low in usefulness, let's give them the benefit of the doubt. You don't need a business degree to work in business, but perhaps your coursework gives you an edge. You don't need an education degree to land a teaching job, but explicitly studying education could enhance your teaching down the road. You don't need a degree in public administration to be a bureaucrat, but maybe such coursework builds a better bureaucrat. By this standard, about 35% of majors end up in the Medium category.

Why put math majors in the same box as students of education or "parks and recreation"? In a sense, no one acquires more technical skills than mathematicians. However, graduates in pure mathematics have no clear occupational track. Many employers hire them for their general quantitative ability. Outside of academia, however, no one pays you to prove theorems.

Low usefulness: The status of most of the majors in this bin—fine arts, philosophy, women's studies, theology, and such—should be uncontroversial. Liberal arts programs uphold the ideal of "knowledge for knowledge's sake." Few even pretend to prepare students for the job market. You could argue I underrate the usefulness of communications and psychology. Don't they prepare students to work in journalism and psychology? Yet this objection is almost as naive as, "Don't history programs prepare students to work as historians?" Psychology, communications, and history's usefulness is Low because they prepare their students for fields where paying jobs are almost impossible to get. In 2008–9, over 94,000 students earned their bachelor's in psychology, but there are only 174,000 practicing psychologists in the country.[10] In the same year, over 83,000 students earned their bachelor's degree in communications. *Total* jobs for reporters, correspondents, and broadcast news analysts number 54,000.[11] Historians, unsurprisingly, have the bleakest prospects of all. There were over 34,000 newly minted history graduates—and only 3,500 working historians in the entire country.[12] The vast majority of students who earn these degrees find employment outside their field. There's no other way to balance the books.

The staunchest defenders of education reject the idea of sorting subjects and majors by "usefulness." How do you know Latin, trigonometry, or Emily Dickinson *won't* serve you on the job? A man told me his French once helped him understand an airport announcement in Paris. Without high school French, he would have missed his flight. Invest years now and one day you might save hours at an airport. See, studying French pays!

These claims remind me of *Hoarders*, a reality show about people whose mad acquisitiveness has ruined their lives. Some hoarders collect herds of cats, others old refrigerators, others their own garbage. Why not throw away some of their useless possessions? Stock answer: "I might need it one day." They "might need" a hundred empty milk cartons.

Taken literally, the hoarders are right: there is a chance they'll need their trash. The commonsense reply is that packing your house with trash is *almost* always a bad idea. You must weigh the storage cost against the likely benefits.

The same goes for knowledge. Yes, you "might need" Latin one day. Maybe a time machine will strand you in ancient Rome. Still, does it make sense to study a dead language for years to prepare for a scenario you almost certainly won't face? You cannot retreat to agnosticism. "No one knows if this trash will come in handy" is a crazy argument for hoarding trash. "No one knows if this knowledge will come in handy" is a crazy argument for hoarding knowledge.

Measured Learning

For human capital purists, education pays only because students learn. Sitting in class year after year is not sufficient; students must actually acquire knowledge. Given the size of the education premium, human capital purists ought to believe students acquire *a lot* of knowledge in school. That's not all. Human capital purists also ought to believe workers *retain* a lot of the knowledge they acquire in school. The labor market pays you for what you know now—not what you knew on graduation day. For human capital purists, the coexistence of a high education premium and low learning/retention would be a puzzle. The less students know and remember, the greater the puzzle.

For the signaling model, in contrast, the coexistence of a high education premium and low learning/retention raises no eyebrows. While students could signal their intelligence, conscientiousness, and conformity by acquiring and retaining a vast stock of knowledge, they don't have to. Students can win employers' favor by learning *enough* to get a good grade—then forgetting every lesson.

How much do schools teach students—and how much do students retain? Measurement is tricky. Using students' standardized test scores implicitly assumes students learn everything they know in school. What about *changes* in students' standardized test scores? A little better, but the basic problem remains: the fact that students improve from grade to grade does not show schooling caused their improvement. Maybe they're maturing, or learning in their spare time.[13] Given these doubts, most researchers strongly prefer controlled experiments: randomly give some kids extra education, then measure their surplus knowledge.[14]

Unfortunately, all these approaches—controlled experiments included—neglect retention. Even if schooling indisputably raises students' scores, the gain could be fleeting. Teachers often lament "summer learning loss": students know less at the end of summer than they did at the beginning.[15] But summer learning loss is only a special case of the problem of *fadeout*: human beings poorly retain knowledge they rarely use.[16] Researchers are especially prone to neglect postgraduation fadeout: they measure how quickly fourth-graders forget third grade, but not how quickly high school graduates forget twelfth grade.

A rare—and discouraging—exception: One major study tested roughly a thousand people's knowledge of algebra and geometry.[17] Some participants were still in high school; the rest were adults between 19 and 84 years old. The researchers had data on subjects' full mathematical education. Main finding: Most people who take high school algebra and geometry forget about half of what they learn within five years and forget almost everything within twenty-five years. Only people who continue on to calculus retain most of their algebra and geometry.

Is long-term retention really this weak? Despite the shortage of long-term retention studies, we can fall back on a compelling shortcut. Instead of measuring the enduring effect of education on adult knowledge, we can place an *upper bound* on that effect. It's a two-step process. Step one: measure adult knowledge about various school subjects. Step two: note that schools can't be responsible for *more than 100%* of what adults know about these subjects. What people now know is therefore an upper bound on the school learning they retain.

My shortcut is easy to implement. Surveys of adults' knowledge of reading, math, history, civics, science, and foreign languages are already on the shelf. The results are stark: Basic literacy and numeracy are virtually the *only* book learning most American adults possess. While the average American spends years and years studying other subjects, they recall next to nothing about them. If schools teach us everything we know about history, civics, science, and foreign languages, their achievement is pitiful.

Literacy and numeracy. In 2003, the United States Department of Education gave about 18,000 randomly selected Americans the National Assessment of Adult Literacy (NAAL).[18] The NAAL tested prose literacy ("knowledge and skills needed to search, comprehend, and use information from continuous texts"), document literacy ("knowledge and skills needed to search, comprehend, and use information from noncontinuous texts"), and quantitative literacy ("knowledge and skills needed to identify and perform computations using numbers that are embedded in printed materials").[19]

For each of these three subtests, the NAAL charitably grades respondents' knowledge as "Below Basic," "Basic," "Intermediate," or "Proficient." Take a look at official examples of Below Basic, Basic, Intermediate, and Proficient Tasks (see Table 2.2). Summing two prices and finding a table in an almanac are Basic (*not* Below Basic) tasks.

Table 2.2: Sample NAAL Tasks, by Level

	Below Basic	Basic	Intermediate	Proficient
Prose	Identify what it is permissible to drink before a medical test, based on a short set of instructions.	Find information in a pamphlet for prospective jurors that explains how citizens were selected for the jury pool.	Summarize the work experience required for a specific job, based on information in a newspaper job advertisement.	Compare viewpoints in two editorials with contrasting interpretations of scientific and economic evidence.
Document	Circle the date of a medical appointment on a hospital appointment slip.	Find a table in an almanac with information on a specified topic.	Find the time a television program ends, using a newspaper television schedule that lists similar programs showing at different times on different channels.	Contrast financial information presented in a table regarding the differences between various types of credit cards.
Quantitative	Add two numbers to complete an ATM deposit slip.	Calculate the cost of a sandwich and salad, using prices from a menu.	Calculate the total cost of ordering office supplies, using a page from an office supplies catalog and an order form.	Calculate an employee's share of health insurance costs for a year, using a table that shows how the employee's monthly cost varies with income and family size.

Source: Kutner et al. 2007, pp. 5–7.

Given these low standards, you might think that virtually all Americans would score at the Intermediate or Proficient level in every subject. Not even close (see Figure 2.3).

The ignorance revealed by the NAAL is numbing. Only modest majorities are Intermediate or Proficient on the prose and document tests. Under half are Intermediate or Proficient on the quantitative test. Reviewing spe-

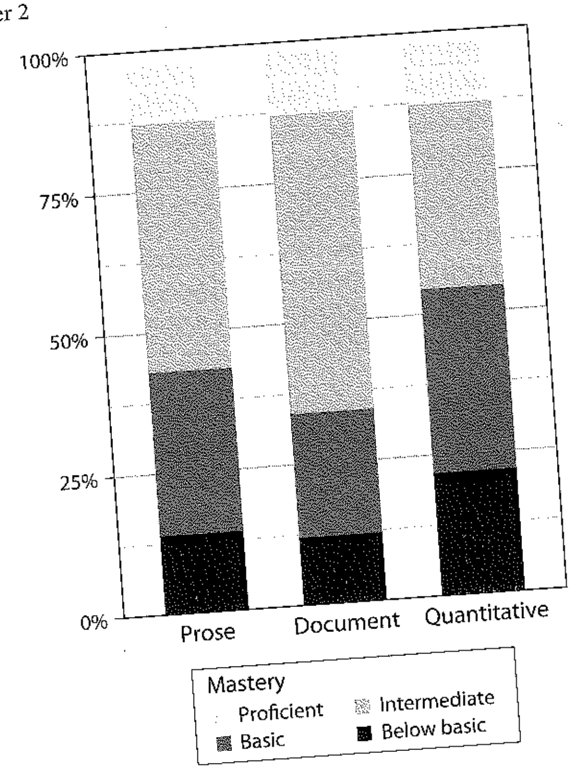

Figure 2.3: NAAL Breakdown: American Adults (2003)
Source: Kutner et al. 2007, p. 13.

cific questions underscores the severity of the ignorance. Barely half know that saving $.05 per gallon on 140 gallons of oil equals $7.00. Thirty-five percent of Americans can't correctly enter a name and address on a Certified Mail form—with no points off for misspelling![20] Schools do far less to cure illiteracy and innumeracy than we'd like to think.

Still, "Illiterate and innumerate compared to what?" is a fair response. Conceivably, in the absence of English and math courses, *all* Americans would be "Below Basic" in *all* three categories. From this perspective, the NAAL puts a fairly high upper bound on schools' total effect on Americans literacy and numeracy. Eighty-six percent of Americans exceed "Below Basic" for prose; 88% exceed "Below Basic" for documents; 78% exceed "Below Basic" for quantitative. For each of the three categories, 13% are actually "Proficient." While these results are meager given the typical American student's years in English and math, they're way better than nothing from employers' point of view.

How do the NAAL results look if you break them down by education? If you mentally picture "high school graduates," you probably see them as Intermediate or Proficient in literacy and numeracy. If you mentally picture "college students," you probably see them as Proficient in literacy and numeracy. Such mental pictures do not fit the facts. Figure 2.4 shows composite scores for high school dropouts, high school graduates with no college, and college graduates.[21]

While today's dropouts almost always spend at least nine years in school,[22] over half remain functionally illiterate and innumerate. Over half of high school grads have less than the minimum skills one would naively expect them to possess. Though college grads spend at least seventeen years in school, under a third have the level of literacy and numeracy we assume of every college freshman.

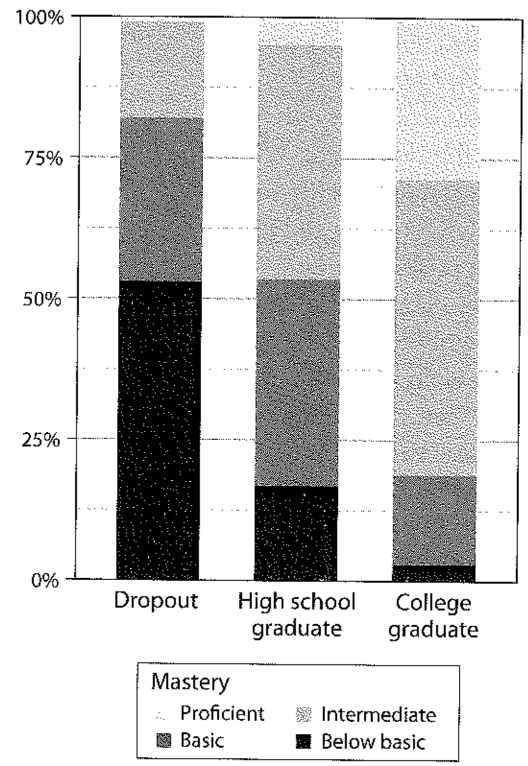

Figure 2.4: NAAL Breakdown: American Adults by Education (2003)
Source: Kutner et al. 2007, pp. 38–39.

History and civics. What does the average American learn in school *besides* basic literacy and numeracy? Precisely how much of our knowledge of history, civics, science, and foreign languages do we owe to education? Once again, we can use surveys of adult knowledge to put a ceiling on the answer.

Starting with history and civics, all national surveys find *severe* ignorance. The American Revolution Center tested 1,001 adult Americans' knowledge of the American Revolution.[23] Eighty-three percent earned failing grades. The Intercollegiate Studies Institute tested over 2,500 adult Americans' knowledge of American government and American history.[24] Seventy-one percent earned failing grades. *Newsweek* magazine gave 1,000 Americans the U.S. Citizenship Test.[25] Thirty-eight percent scored too low to become citizens of their own country. On the 2000 American National Election Study, the typical person got 48% of the factual questions right; you would expect 28% by guessing.[26] These results are consistent with a vast academic literature on Americans' (lack of) political knowledge.[27]

You could blame low scores on the difficulty of the tests rather than the ignorance of the test takers. When you read them, however, you'll notice the public struggles with easy multiple choice questions. How many American adults know the Bill of Rights is part of the Constitution? The American Revolution Center reports a dismal 57%, but the truth is far worse. Since there were only four response options, you would expect roughly 25% of the ignorant to guess the right answer by chance. And this is no isolated blind spot. Table 2.3 shows some other basic history and civics questions, with scores corrected for guessing.[28]

One could look at these facts and conclude the public's historical and civic knowledge is no worse than its literacy. Yet such optimism overlooks a key point: knowing half a subject's *basic* facts does not make you "halfway proficient." If you know only half the letters in the alphabet, you are illiterate. Why? Because you lack knowledge of basic facts on which all reading depends. The same holds for the ABCs of history and civics. Not knowing the three branches of government isn't like not knowing *Hamlet*; it's like not knowing the letter "h." If you don't know that the Civil War came after the Declaration of Independence, you don't understand American history. If you don't know which parties control the House and the Senate, you don't understand American politics.

Table 2.3: Adult History/Civics Knowledge: Some Telling Questions

Question	Response Options	% Who Answer Correctly	% Who Really Know
From the American Revolution: Who Cares? Survey			
Which of the following rights is not protected by the Bill of Rights?	Freedom of speech Trial by jury The right to bear arms *Right to vote*	39%	21%
The U.S. Constitution establishes which of the following forms of government in the United States?	A direct democracy *A Republic* A Confederacy An Oligarchy	42%	24%
Which of the following events came BEFORE the Declaration of Independence?	*Foundation of Jamestown, VA* The Civil War The Emancipation Proclamation The War of 1812	49%	26%
When did the American Revolution begin? Was it in the . . .	*1770s* 1640s 1490s 1800s	65%	55%
From *Our Fading Heritage* (Cribb 2008, p. 18)			
What are the three branches of government?	[Free response]	50%	50%
The Bill of Rights explicitly prohibits . . .	Prayer in public school Discrimination based on race, sex, or religion The ownership of guns by private individuals *Establishing an official religion for the United States* The president from vetoing a line item in a spending bill	26%	8%
What part of the government has the power to declare war?	*Congress* The president The Supreme Court The Joint Chiefs of Staff	54%	39%

If taxes equal government spending, then:	Government debt is zero Printing money no longer causes inflation Government is not helping anybody *Tax per person equals government spending per person* Tax loopholes and special-interest spending are absent	28%	10%
From the 2000 American National Election Study			
Would you say that compared to 1992, the federal budget deficit is now smaller, larger, or about the same?	Larger About the Same *Smaller*	58%	41%
Is Al Gore more liberal than George Bush, more conservative, or about the same?	*More* About the Same Less	57%	44%
Do you happen to know which party had the most members in the House of Representatives in Washington BEFORE the election (this/last) month?	Democrats *Republicans*	55%	22%
Do you happen to know which party had the most members in the U.S. Senate BEFORE the election (this/last) month?	Democrats *Republicans*	50%	21%
Correct responses in italics.			

The average American high school graduate completes four years of history/social studies coursework. Four years: ample time to learn the ABCs of history and civics by heart, to acquire the knowledge base to discuss America's past, present, and future. Yet few adults possess this knowledge. If we owe everything we know about history and civics to history and civics classes, we owe next to nothing.

Science. Few American adults know the ABCs of science. The General Social Survey provides the best evidence of their ignorance. In recent years, this survey has tested the public's knowledge of twelve elementary scientific facts (see Table 2.4).[29] Adults correctly answer 60%. While this may seem low, it is a gross overstatement. These are true/false questions, so people should get 50% only guessing!

Table 2.4: Adult Science Knowledge: Some Telling Questions

Question	Response Options	% Who Answer Correctly	% Who Really Know
From the General Social Survey 2006–10			
The center of the Earth is very hot.	*TRUE* FALSE	81%	76%
The continents on which we live have been moving their locations for millions of years and will continue to move in the future.	*TRUE* FALSE	78%	68%
Does the Earth go around the Sun, or does the Sun go around the Earth?	*Earth goes around the Sun* Sun goes around the Earth	73%	54%
All radioactivity is man-made.	TRUE *FALSE*	68%	50%
Electrons are smaller than atoms.	*TRUE* FALSE	52%	32%
Lasers work by focusing sound waves.	TRUE *FALSE*	46%	25%
The universe began with a huge explosion.	*TRUE* FALSE	33%	−3%
The cloning of living things produces genetically identical copies.	*TRUE* FALSE	80%	71%
It is the father's gene that decides whether the baby is a boy or a girl.	*TRUE* FALSE	62%	39%
Ordinary tomatoes do not contain genes, while genetically modified tomatoes do.	TRUE *FALSE*	47%	29%

Antibiotics kill viruses as well as bacteria.	TRUE *FALSE*	53%	14%
Human beings, as we know them today, developed from earlier species of animals.	*TRUE* FALSE	44%	2%

Accounting for guessing, the public's scientific illiteracy is astonishing. Barely half of American adults know the Earth goes around the sun. Only 32% know atoms are bigger than electrons. Just 14% know that antibiotics don't kill viruses. Knowledge of evolution barely exceeds zero. Knowledge of the Big Bang is actually *less* than zero; respondents would have done better flipping a coin. Guess-corrected, the average respondent knows 4.6 answers. If adults learned everything they know about these twelve juvenile questions in high school science, they learned 1.4 answers per *year*.[30]

Educators can arguably blame the majority's disbelief in the Big Bang and evolution on Christian fundamentalism. Yet ignorance of the ABCs of science is nondenominational. Only 7% of adult Americans who *deny* the Bible's literal truth answered all twelve questions correctly.[31] Given the ease of the questions, we shouldn't conclude Americans' knowledge of science is mediocre. We should conclude Americans' knowledge of science is virtually nonexistent.

Foreign languages. High school graduates average two years of foreign language coursework. What do adults have to show for it? The General Social Survey allows rather precise estimates. It asks respondents, "Can you speak a language other than English?," "How well do you speak that language?," and "Is that a language you first learned as a child at home, in school, or is it one that you learned elsewhere?"[32]

The results could scarcely be worse. Schools make virtually *no one* fluent in a foreign language (see Figure 2.5). Only .7% claim to have learned a foreign language "very well" in school; another 1.7% claim to have learned a foreign language "well" in school. Since these are self-reports, true linguistic competence must be even worse. The hard truth: if you didn't acquire fluency in the home, you almost certainly don't have it.

Classroom sitting is easily measured and plainly massive. In our society, virtually everyone sits in school for over a decade. Yet this hardly

shows students' *learning* or *retention* is massive. Adult knowledge is a superior measure: while people obviously learn outside of school, their total knowledge puts a ceiling on what they learned inside of school. The results are disheartening. Most Americans possess basic literacy and numeracy, but only 13% are proficient. For history, civics, science, and foreign language, few Americans grasp the ABCs. The claim that schools "teach these subjects" is an overstatement. Schools only "teach *of* these subjects." After *years* of exposure, American adults know history, civics, science, and foreign languages exist. That's about it.

Americans' staggering ignorance may not be a death blow for human capital purism, but it is an awkward fact. If we learn so little in school, why do employers so heavily reward education? The simplest response is that employers, like teachers, grade on a curve. Intermediate literacy and numeracy horrify intellectuals. From an employer's point of view, however, intermediate is way better than basic—or below basic.

The main weakness with this response: even adults who did *well* in school usually lack basic knowledge of history, civics, science, and foreign language. Yet employers still hold failing grades in these subjects against you. If you fail Spanish, you don't finish high school, you can't go

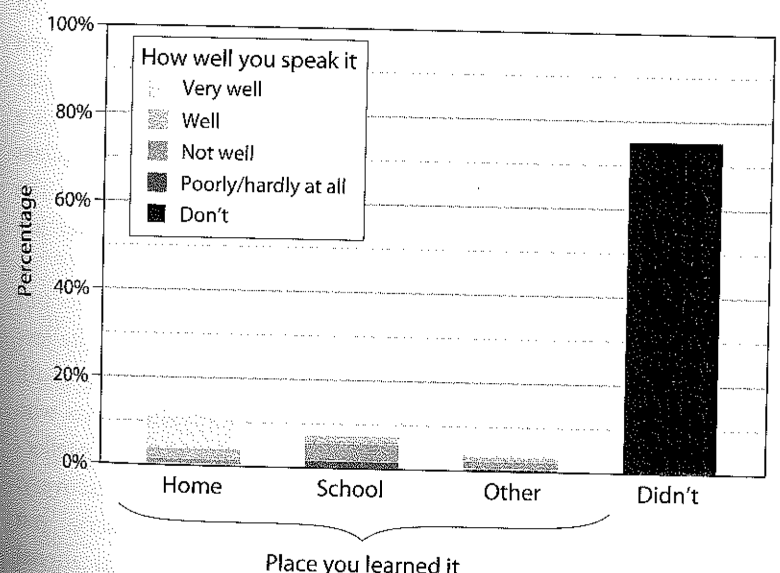

Figure 2.5: The Level and Origin of Foreign Language Competence in the General Social Survey

to college, and the labor market punishes you—even though most B.A.s are equally monolingual. How can human capital purists explain that?

The Relevance of Relevance

Youths spend years studying subjects adults rarely use on the job. Adults are amazingly ignorant about subjects they studied since childhood. Is there any way to square these facts with the popular assumption that employers value your education solely because they value your learning?

There is. Maybe course catalogs and standardized tests fail to capture most of what students learn. When students challenge the relevance of their lessons, teachers often reply, "I teach you how to think—not what to think." Teachers could dismiss adult ignorance in roughly the same way: "They learned how to think—not what to think." So what if most students won't use European history or the periodic table on the job? "Relevance" is irrelevant. As long as students learn *something*, they tacitly acquire marketable skills en passant.

If these teachers are right, defenders of education can draw a line in the sand: the prevalence of "useless" subjects and scarcity of "measured learning" is an illusion. The fact that you neither use nor remember your coursework in history and science does not make your coursework a waste of time. A history class can teach critical thinking; a science class can teach logic. Thinking—*all* thinking—builds mental muscles. The bigger students' mental muscles, the better they'll be at whatever job they eventually land.

Comforting claims. They sooth teachers' consciences and quiet our self-doubt. But are they true—or merely wishful thinking? Can believers in the power of learning how to think back up teachers' boasts with hard evidence? For the most part, no. Educational psychologists who specialize in "transfer of learning" have measured the hidden intellectual benefits of education for over a century.[33] Their chief discovery: education is narrow. As a rule, students learn only the material you specifically teach them . . . if you're lucky. In the words of educational psychologists Perkins and Salomon, "Besides just plain forgetting, people commonly fail to marshal what they know effectively in situations

outside the classroom or in other classes in different disciplines. The bridge from school to beyond or from this subject to that other is a bridge too far."[34]

Many experiments study transfer of learning under seemingly ideal conditions. Researchers teach subjects how to answer Question A. Then they immediately ask their subjects Question B, which can be handily solved using the same approach as Question A. Unless A and B look alike on the surface, or subjects get a heavy-handed hint to apply the same approach, learning how to solve Question A rarely helps subjects answer Question B.[35]

One classic experiment teaches subjects how to solve a military puzzle, then tests whether subjects apply what they learned to solve a medical puzzle. The military puzzle:

> A general wishes to capture a fortress located in the center of a country. There are many roads radiating outward from the fortress. All have been mined so that while small groups of men can pass over the roads safely, any large force will detonate the mines. A full-scale direct attack is therefore impossible. The general's solution is to divide his army into small groups, send each group to the head of a different road, and have the groups converge simultaneously on the fortress.

The medical puzzle:

> Suppose you are a doctor faced with a patient who has a malignant tumor in his stomach. It is impossible to operate on the patient, but unless the tumor is destroyed the patient will die. There is a kind of ray that can be used to destroy the tumor. If the rays reach the tumor all at once at a sufficiently high intensity, the tumor will be destroyed. Unfortunately, at this intensity the healthy tissue that the rays pass through on the way to the tumor will also be destroyed. At lower intensities the rays are harmless to healthy tissue, but they will not affect the tumor either. What type of procedure might be used to destroy the tumor with the rays, and at the same time avoid destroying the healthy tissue?

The connection:

> There is an analogous "convergence" solution to the radiation problem. The doctor could direct multiple low-intensity rays toward the tumor simultaneously from different directions, so that the healthy tissue will be left unharmed, but the effects of the low-intensity rays will summate and destroy the tumor.[36]

Since subjects hear these two stories back to back, you might think almost everyone would leap to the convergence solution for the medical problem. They don't. A typical success rate is 30%. Since about 10% of subjects who *don't* hear the military problem offer the convergence solution, only one in five subjects transferred what they learned. To reach a high (roughly 75%) success rate, you need to teach subjects the first story, then bluntly *tell* them to use the first story to solve the second.[37]

To repeat, such experiments measure how humans "learn how to think" under *ideal* conditions: teach A, immediately ask B, then see if subjects use A to solve B. Researchers are leading the witness. As psychologist Douglas Detterman remarks:

> Teaching the principle in close association with testing transfer is not very different from telling subjects that they should use the principle just taught. Telling subjects to use a principle is not transfer. It is following instructions.[38]

Under less promising conditions, transfer is predictably even worse. Making the surface features of A and B less similar impedes transfer.[39] Adding a time delay between teaching A and testing B impedes transfer.[40] Teaching A, then teaching an irrelevant distracter problem, then testing B, impedes transfer.[41] Teaching A in a classroom, then testing B in the real world impedes transfer.[42] Having one person teach A and another person test B impedes transfer.[43]

To apply schoolwork in the real world, you must normally overcome *each and every one* of these hurdles. You must see through surface features to underlying structure. You must select the few relevant lessons, and ignore the rest. You must remember relevant lessons years or decades after encountering them. You must apply what you learned in a nonacademic location, without your original teacher (or any teacher!) to hold your hand. No wonder even transfer optimists like Robert Haskell lament:

> Despite the importance of transfer of learning, research findings over the past nine decades clearly show that as individuals, and as educational institutions, we have failed to achieve transfer of learning on any significant level.[44]

You might protest that transfer experiments are too artificial or superficial to show much about real-world education. If each lesson microscopically hones your thinking skills, the total effect of education on general thinking skills could still be large. Researchers generally find, for

example, that college attendance boosts scores on tests of critical thinking.[45] But this is a hollow victory: researchers also generally find that education fails to *durably* improve critical thinking *outside the classroom*.[46]

The most impressive study of the effect of education on thinking skills collected a sample of first-year high school students, fourth-year high school students, first-year college students, fourth-year college students, first-year graduate students, and fourth-year graduate students.[47] The researcher then orally tested their *informal* reasoning on issues like, "Does violence on television significantly increase the likelihood of violence in real life?" and "Would a proposed law in Massachusetts requiring a five-cent deposit on bottles and cans significantly reduce litter?" By design, there were no right or wrong answers; the point of the test was to measure the *quality* of subjects' reasoning on issues that "permitted elaborate arguments on both sides of the case, led to divided opinions, proved accessible even to the first-year high school group, and did not depend for their analysis on background knowledge that varied greatly across the subject population."[48] Judges listened to recordings of the original responses, counting (a) number of sentences, (b) number of lines of argument, (c) number of objections considered, and (d) how many times the experimenter had to remind the subject to stay on topic. The experimenter also asked subjects to *explain* the connection between one of their arguments and their conclusion. Judges graded the quality of these explanations, as well as overall quality of reasoning.

The measured effect of education on informal reasoning, though positive, was tiny. Fourth-year high school students were slightly better than first-year high school students. Fourth-year college students were no better than first-year college students. Fourth-year graduate students were barely better than first-year graduate students. Table 2.5 shows the average overall quality of their reasoning on a 1–5 scale (5 being highest).

Table 2.5: Average Overall Reasoning Score (1–5 scale, 5 being highest)

	1st Year	4th Year
High School	1.6	2.1
College	2.8	2.8
Graduate School	3.1	3.3

Source: Perkins 1985, p. 566.

Respondents with more educational credentials definitely get higher scores. The point is that students barely improve *between* their first and fourth years of study.[49] While people with better reasoning skills do complete more education, their reasoning skills are *better at the outset.* If education seriously showed students "how to think," three additional years of study would sharply amplify their initial advantage. Yet students' scores barely budge.

Other evidence is equally disappointing. One researcher tested several hundred Arizona State University students' ability to "apply statistical and methodological concepts to reasoning about everyday-life events."[50] How, for example, would subjects assess the claim that students should eat more nutritiously because "the majority of students needing psychological counseling had poor dietary habits"? Would subjects realize psychological problems might *cause* poor dietary habits, rather than the other way around? Would they feel the need for experimental evidence? No. In the author's words:

> The results were shocking: Of the several hundred students tested, many of whom had taken more than six years of laboratory science in high school and college and advanced mathematics through calculus, almost none demonstrated even a semblance of acceptable methodological reasoning about everyday-life events described in ordinary newspaper and magazine articles. The overwhelming majority of responses received a score of 0. Fewer than 1% obtained the score of 2 that corresponded to a "good scientific response." Totally ignoring the need for comparison groups and control of third variables, subjects responded to the "diet" example with statements such as "It can't hurt to eat well."[51]

The point is not merely that college students are bad at reasoning about everyday events. The point is that college students are bad at reasoning about everyday events despite *years* of coursework in science and math. Believers in "learning how to learn" should expect students who study science to absorb the scientific method, then habitually use that fruitful method to analyze the world. This scarcely occurs. By and large, college science teaches students *what* to think about topics on the syllabus, not *how* to think about the world.

Counterexamples do exist, but compared to teachers' high hopes, effects are modest, narrow, and often only in one direction. One experiment randomly taught one of two structurally equivalent topics: (a) the algebra of arithmetic progression, or (b) the physics of constant acceleration.[52] Researchers then asked algebra students to solve the physics problems, and physics students to solve the algebra problems. Only 10% of the physics students used what they learned to solve the algebra problems. But a remarkable 72% of the algebra students used what they learned to solve the physics problems. Applying abstract math to concrete physics comes much more naturally than generalizing from concrete physics to abstract math.

More impressively, studying statistics enhances statistical reasoning on real-life questions outside the classroom. One research team phoned 193 male introductory statistics students from the University of Michigan in their homes. Interviewers withheld the fact that they were targeting statistics students. Half the subjects were interviewed in the semester's first week; the rest were interviewed in the semester's last week.[53] The "official" purpose of the phone call was to solicit students' opinions about sports. The true purpose was to see if statistics students would spontaneously apply their lessons to a novel topic (sports) in a nonacademic setting (their homes).[54] Researchers recorded the conversations, measuring the presence and quality of statistical reasoning.

A semester of statistics mattered, but the effect was uneven. Students substantially improved on two out of four statistically relevant questions. Why does the Rookie of the Year usually perform worse in his second year? At the beginning of the semester, only 16% gave a statistical answer; at the end of the semester, 37% did so. Why are top batting averages higher after two weeks of play than at the end of the season? At the beginning of the semester, 50% gave a statistical answer; at the end, 70% did so. The *quality* of statistical reasoning on these two questions improved as well. On the other two statistically relevant questions, however, the experimenters were surprised to find no gain.[55]

Compared to most experiments, the sports/statistics study found impressive transfer of learning. Compared to teachers' aspirations, however, the results are a let-down. The experimenters deliberately wrote easy questions, and the participants were students at one of the most elite universities in the country.[56] Yet statistical reasoning improved on only half the questions, and most students did not improve. Furthermore, the researchers measured statistical learning at its peak: the final week of the class. How much of their modest edge would intro stats students retain months or years after the final exam?

College majors also measurably hone *specific* kinds of reasoning. One ambitious study tested undergraduates at the University of Michigan during the first term of their first year, then retested the same students during the second term of their fourth year.[57] The test covered verbal reasoning, statistical reasoning, and conditional reasoning. Researchers included four kinds of majors: natural sciences, humanities, social sciences, and psychology.

Each major sharply improved on precisely one subtest. Social science and psychology majors became much better at statistical reasoning—the ability to apply "the law of large numbers and the regression or base rate principles" to both "scientific and everyday-life contexts." Natural science and humanities majors became much better at conditional reasoning—the ability to correctly analyze "if . . . then" and "if and only if" problems.

On remaining subtests, however, gains after three and half years of college were modest or nonexistent. Social scientists' verbal and conditional reasoning scores slightly fell. Psychologists' verbal scores slightly rose, but their conditional reasoning failed to improve. Natural science and humanities majors gained slightly in verbal reasoning, and modestly in statistical reasoning.

With zero transfer, psychologists could only statistically analyze psychological issues, and natural scientists could only conditionally reason about their scientific specialty. Matters are not quite so dire. As the researchers conclude, their results show "different undergraduate disciplines teach different kinds of reasoning to different degrees."[58] Yet their results also undermine the view that students gain general reasoning skills. Students primarily improve in the very tasks they study and practice. Even this isn't guaranteed; humanities majors' verbal reasoning barely budged.

The same researchers also measured the effect of two years of graduate training on verbal, statistical, and conditional reasoning.[59] The subjects were law students, medical students, and graduate students in psychology and chemistry at the University of Michigan. No one, not even law students, improved much in verbal reasoning. Chemists' scores on all three subtests stayed about the same. But medical and especially psychology students improved in statistical reasoning, and law, medical, and psychology students all improved in conditional reasoning.

Takeaway: if all goes well, students learn what they study and practice. Psychology and medical students heavily use statistics, so they improve in statistics; law and chemistry students rarely encounter statistics, so they don't improve in statistics. Why don't chemistry students improve in conditional reasoning? Because unlike psychology, medical, and law students, chemists have "little need to differentiate among the various types of causal relations because chemistry deals primarily with necessary-and-sufficient causes."[60] What chemistry students learn is . . . chemistry.

Actually, that's optimistic. Educational psychologists have also discovered that much of our knowledge is "inert." Students who excel on exams frequently fail to apply their knowledge to the real world.

Take physics. A student once joked, "Objects in motion remain in motion in the classroom, but come to rest on the playground," but the pedagogical problem is serious.[61] Renowned psychologist Howard Gardner explains:

> Researchers at Johns Hopkins, M.I.T., and other well-regarded universities have documented that students who receive honor grades in college-level physics courses are frequently unable to solve basic problems and questions encountered in a form slightly different from that on which they have been formally instructed and tested.[62]

If you throw a coin straight up, how many forces act on it midair? The textbook answer is "one": after it leaves your hand, the *only* force on the coin is gravity.[63] The popular answer, however, is "two": the force of the throw keeps sending it up, and the force of gravity keeps dragging it down. Popular with whom? Virtually everyone—physics students included.[64] At the beginning of the semester, only 12% of college students in introductory mechanics get the coin problem right. At the end of the semester, 72% still get it wrong. After students learn how to handle complex homework and exam problems, few apply their lessons to simple real-world cases.

The same goes for students in biology, mathematics, statistics, and, I'm embarrassed to say, economics.[65] I strive to teach my students how to "think like economists," to connect lectures to the real world and daily life. When teaching educational signaling in labor economics, I tell students:

> Do you think you're going to get a job that uses your knowledge of educational signaling? Probably not. Yet if you don't learn the material, employers hold it against you. That's the puzzle.

My exams are designed to measure comprehension, not memorization. They're completely open book. Yet students' performance reliably disappoints me. Half the answers repeat semirelevant passages from the notes and hope for mercy. In a good class, four exams out of forty demonstrate true economic understanding. Howard Gardner captures my experience perfectly:

> Nearly every teacher I know would claim to teach for understanding; certainly I would make that claim myself. But if pressed to demonstrate that our students understand . . . we soon realize how slender is the reed of our confidence.[66]

Transfer researchers usually begin their careers as idealists. Before studying educational psychology, they take their power to "teach students how to think" for granted. When they discover the professional consensus against transfer, they think they can overturn it. Eventually, though, young researchers grow sadder and wiser. The scientific evidence wears them down—and their firsthand experience as educators finishes the job. Hear the pedagogical odyssey of psychologist Douglas Detterman:

> When I began teaching, I thought it was important to make things as hard as possible for students so they would discover the principles for themselves. I thought the discovery of principles was a fundamental skill that students needed to learn and transfer to new situations. Now I view education, even graduate education, as the learning of information. I try to make it as easy for students as possible. Where before I was ambiguous about what a good paper was, I now provide examples of the best papers from past classes. Before, I expected students to infer the general conclusion from specific examples. Now I provide the general conclusion and support it with specific examples. In general, I subscribe to the principle that you should teach people exactly what you want them to learn in a situation as close as possible to the one in which the learning will be applied. I don't count on transfer and I don't try to promote it except by explicitly pointing out where taught skills may be applied.[67]

Detterman is admittedly fatalistic even for an educational psychologist. Many of his peers struggle to learn from the rare examples of successful transfer.[68] A few earnestly claim to have discovered novel teaching techniques that *do* reliably lead to transfer.[69] For our purposes, however, this debate is a red herring. Though some educational

psychologists deny that education *must* yield minimal transfer, almost all admit that actually existing education *does* yield minimal transfer. The upshot: human capital purists can't credibly dismiss the disconnect between what we learn in school and what we do on the job. Relevance is highly relevant. If what you learn in school lacks obvious real-world applications, you'll probably never apply it. When a rare opportunity to use trigonometry knocks, it knocks too faintly to hear.

The clash between teachers' grand claims about "learning how to learn" and a century of careful research is jarring. Yet commonsense skepticism is a shortcut to the expert consensus. Teachers' plea that "we're mediocre at teaching what we measure, but great at teaching what we don't measure" is comically convenient. When someone insists their product has big, hard-to-see benefits, you should be dubious by default—especially when the easy-to-see benefits are small.

In the classroom, educators strive to achieve tangible, self-contained goals—like teaching key Civil War facts. Should we believe educators are *better* at intangible, open-ended goals like teaching students "how to think"? When we hand teachers an explicit goal and measure their success, it's disappointing. Should we believe teachers are *better* at achieving unmeasured afterthoughts? Students quickly forget most of the material we deliberately try to teach them. Should we believe that students retain *more* of the skills we idly hope they'll acquire?

You could object common sense cuts both ways. The strongest reason to believe in "learning how to learn" is also a commonsense claim:

> Since physical exercise builds physical muscles, we should expect mental exercise to build mental muscles.

But on reflection, this is another reason to *dis*believe in "learning how to learn." You don't exercise your legs to improve your bench press. You don't even exercise your right leg to strengthen your left leg. Instead, you exercise the muscles you seek to build. Why would "mental muscles" be any less specific? Furthermore, when you stop going to the gym, your physical muscles soon atrophy.[70] Why would "mental muscles" be any slower to wither? If exercise analogies prove anything, they prove our education system rests on educators' conceit—the self-serving line that when we teach students whatever interests us, they durably acquire whatever skills they need to succeed in life.

Making You Smarter

While educators often promise to teach students how to think, they rarely vow to raise students' intelligence. Trying to "make your pupils smarter" smacks of hubris. However, when you look at data on IQ—psychologists' standard measure of intelligence—education matters. Summer vacation, intermittent attendance, delayed school entry, and dropping out all measurably depress IQ.[71] Some experimental early childhood programs have increased IQ by over 30 points—moving kids' performance from roughly the 2nd percentile to the 50th percentile of their age group.[72] Extra years of education usually seem to boost IQ.[73] Studies that carefully measure students' time show IQ rises more on school days than non-school days.[74] Isn't this conclusive evidence that education makes us smarter?

Not really. While the facts are secure, the interpretation is shaky. The first major worry: *people can sharply improve on virtually any test by practicing*—and a little practice goes a long way. A major review pulled together fifty relevant studies of practice on cognitive tests. On average, "a candidate who scored at the 50th percentile on the first test could be expected to score at the 60th percentile on the second test and at the 71st percentile on the third test."[75] Explicit coaching—"teaching to the test"—works even better.[76]

A cockeyed optimist might rejoice that mankind is only a few hours of practice away from massive intelligence gains. This optimism, however, leads to absurdity: Can you transform average students into geniuses by handing them the answer key before their IQ test? Most researchers draw the sobering conclusion that test preparation yields only "hollow gains."[77] Preparation inflates *measured* intelligence without raising *genuine* intelligence.[78]

The fact that test preparation yields large but hollow gains hardly shows that *all* large gains are hollow. Still, the power of preparation should make us suspicious. Maybe education raises IQ because education is a diluted form of IQ test preparation. As psychologist Stephen Ceci explains:

> It is through direct forms of instruction . . . that children learn the answers to many of the questions that appear on a popular IQ (and other aptitude) tests. For example, within a given grade level there is a correlation between the total number of hours of schooling a child receives and scores on verbal and mathematical aptitude tests. Similarly, there are negative correlations between the total number of teacher or student absences and scores on such tests. Also, quantitative and language-related scores are strongly correlated with the length of the school day and with the actual amount of time on task, beginning in first grade. So it makes intuitive sense that much of the knowledge that aptitude tests, including IQ, tap is accumulated through direct encounters with the educational system. Answers to questions on the WISC-R, such as "In what continent is Egypt?"; "Who wrote Hamlet?"; "What is the boiling point of water?"; and "How many miles is New York from L.A.?" are probably learned through direct teaching methods. Teachers may not be aware that they are teaching answers to questions on IQ tests, but this is precisely what they are doing in their history, reading, literature, geography, and math classes.[79]

Ceci also notes that schools teach students to offer the *kinds* of answers IQ tests favor. How are an apple and an orange alike? IQ tests award only partial credit for such factually correct answers as, "They're both round," "They're both edible," or "They both have seeds." For full credit, you have to say, "They're both fruits." School also trains students to sit still and pay attention. These help test scores but aren't "intelligence" in any normal sense of the word.[80]

If education truly raised intelligence, education would enhance performance on all sorts of cognitive challenges—in and out of the classroom. In reality, the gains are spotty. Probably the best study of the effect of education on IQ looks at the scores of over one hundred thousand 18-year-old Swedish men.[81] The researchers knew each student's exact age and test date, yielding a precise measure of their time in school. Major finding: school days noticeably raise scores on synonym and technical comprehension subtests *without* raising scores on spatial and logic subtests. The authors infer that education raises "crystallized intelligence" but not "fluid intelligence." A better interpretation, though, is that education improves some specific skills without increasing intelligence *at all*. Given how little students usually learn, Swedish schools' measured effect on the synonym and technical comprehension subtests is impressive. Still, to equate subject-specific gains with higher intelligence smacks of double-counting.

Worries about "hollow IQ gains" are admittedly a tad philosophical. The other major worry about the effect of education on IQ, however, is completely pragmatic. Suppose for the sake of argument that

IQ perfectly captures genuine intelligence. When IQ goes up, genuine intelligence automatically rises in sync. Even in this scenario, a large effect of education on IQ would be impressive only if it were *lasting*. In the short story "Flowers for Algernon," a mentally retarded man named Charlie Gordon receives an experimental treatment to cure his disability.[82] Charlie's intelligence eventually rises to the level of genius, but the transformation is tragically short-lived. By the end of the story, all of Charlie's intellectual progress evaporates. In one sense, the experiment worked. In a deeper sense, it failed.

"Flowers for Algernon" is science fiction, but life mirrors art. Making IQ higher is easy. *Keeping* IQ higher is hard. Researchers call this "fadeout." Fadeout for early childhood education is especially well documented. After six years in the famous Milwaukee Project, experimental subjects' IQs were 32 points higher than controls'. By age fourteen, this advantage had declined to 10 points.[83] In the Perry Preschool program, experimental subjects gained 13 points of IQ, but all this vanished by age 8.[84] Head Start raises preschoolers' IQs by a few points, but gains disappear by the end of kindergarten.[85]

You could object that preschoolers are unusually prone to forget what they learn, but the pattern extends all through high school. Extensive research on "summer learning loss" compares students' scores at the end of one school year to their scores at the beginning of the next school year. The average student intellectually regresses roughly one full month during a three-month summer vacation.[86] The older the students, the *steeper* their decline. For reading, to take the clearest case, first- and second-graders actually slightly improve over the summer. By the time students are in middle school, however, one summer vacation wipes out over three months of reading proficiency.[87]

Reformers tend to see summer learning loss as an argument for year-round school. If summer makes students stupid, let's abolish summer. The flaw in their thinking: everyone graduates *eventually*. Once you graduate, you're no longer in school—and learning loss kicks in. To quote "Tiger Mother" Amy Chua, "Every day you don't practice is a day that you're getting worse."[88]

Does education have *any* effect on genuine intelligence? Despite decades of research, we really don't know. What we do know is that education has far less effect than meets the eye. The effect of education on intelligence may not be *entirely* hollow, but it is largely hollow. The effect of education on intelligence may not be *entirely* temporary, but it is largely temporary.

In any case, suppose each year of school permanently made you a whopping 3 IQ points smarter. According to standard estimates, this would raise your earnings by about 3%, leaving a supermajority of the education premium unexplained.[89]

How People Get Good at Their Jobs

If schools teach few job skills, transfer of learning is mostly wishful thinking, and the effect of education on intelligence is largely hollow, how on earth do human beings get good at their jobs? The same way you get to Carnegie Hall: *practice*. People learn by doing specific tasks over and over. To get better at piloting, you fly planes; to get better at obstetrics, you deliver babies; to get better at carpentry, you build houses.[90]

For the unskilled, progress is easy. Given commonsense conditions, it's almost guaranteed. In the words of K. Anders Ericsson, the world's leading expert on expertise, novices improve as long as they are, "1) given a task with a well-defined goal, 2) motivated to improve, 3) provided with feedback, and 4) provided with ample opportunities for repetition and gradual refinements of their performance."[91] Before long, though, the benefit of mere practice plateaus. To really get good at their jobs, people must advance to *deliberate* practice. They must exit their comfort zone—raise the bar, struggle to surmount it, repeat. As Ericsson and coauthors explain:

> You need a particular kind of practice—*deliberate practice*—to develop expertise. When most people practice, they focus on the things they already know how to do. Deliberate practice is different. It entails considerable, specific, and sustained efforts to do something you *can't* do well—or even at all.[92]

Attaining world-class expertise in chess, music, math, tennis, swimming, long-distance running, writing, and science requires many years of deliberate practice.[93] Fortunately, the labor market offers plenty of subpinnacle opportunities. A few thousand hours of deliberate practice rarely makes you a superstar, but is ample time to get good in most occupations.[94] People don't become skilled workers by dabbling in a dozen different school subjects. They become skilled workers by devoting years to their chosen vocation—by doing their job and striving to do it better.[95]

Discipline and Socialization

> "I doubt very seriously whether anyone will hire me."
> "What do you mean, babe? You a fine boy with a good education."
> "Employers sense in me a denial of their values."
> —John Kennedy Toole, *A Confederacy of Dunces*[96]

Educators boast that they teach their students how to think. Laymen tend to favor a colder, more credible story about what kids learn in school: discipline and socialization. Life isn't a picnic—or a game of solitaire. Schools build discipline by making students show up on time, sit still, keep their mouths shut, follow orders, and stay awake. Schools build social skills by making students cooperate, manage conflict, work as a team, dress nicely, and speak properly. The typical worker spends the day doing boring work in a hierarchical organization. Perhaps education acclimates children to their future role.

These are all plausible claims, especially when you ponder the many thousands of hours of drudgery and mingling students endure. Yet discipline-and-socialization stories overlook a vital question: *If students weren't in school, what would they be doing instead?* Young adults who spent their teens sitting home alone playing video games might be feral. But what if young adults spent their teens working? Work teaches discipline. Work teaches social skills. Why would education be any better at readying us for the world of work than the world of work itself?

What school inculcates is not so much the work ethic as the *school* ethic. The two ethics do not perfectly coincide. Both school and work teach you to follow orders and cooperate with others. Yet they define and measure success differently. School elevates abstract understanding over practical results, passing exams over passing the market test, and fairness over dollars and cents. Andrew Carnegie caustically captures this tension:

> Men have sent their sons to colleges to waste their energies upon obtaining a knowledge of such languages as Greek and Latin, which are of no more practical use to them than Choctaw. . . . They have been crammed with the details of petty and insignificant skirmishes between savages, and taught to exalt a band of ruffians into heroes; and we have called them "educated." They have been "educated" as if they were destined for life upon some other planet than this. . . . What they have obtained has served to imbue them with false ideas and to give them a distaste for practical life. . . . Had they gone into active work during the years spent at college they would have been better educated men in every true sense of that term. The fire and energy have been stamped out of them, and how to so manage as to live a life of idleness and not a life of usefulness has become the chief question with them.[97]

Educators who dismiss Carnegie as a Neanderthal or philistine prove my point: school inculcates many attitudes that, regardless of their moral worth, impede on-the-job success. If you're preparing kids for their adult roles, a year of work experience instills more suitable discipline and socialization than a year of school.

professional roles, you mean

The imperfect overlap between the school ethic and the work ethic is especially blatant in modern American colleges. Fifty years ago, college was a full-time job. The typical student spent 40 hours a week in class or studying.[98] Since the early 1960s, effort collapsed across the board. "Full-time" college students average 27 hours of academic work per week—and only 14 hours of studying. As the leading researchers on this topic explain:

> No group appears to have bucked the trend. . . . Study times fell for all choices of major, overall and within both subperiods. Students at liberal arts colleges studied more than other students, but study times fell at all types of colleges. . . . Finally, data on SAT scores and school size . . . show declines in study time for students of all ability levels and at universities of all sizes and levels of selectivity.[99]

What are students doing with their extra free time? Having fun. Instead of being socialized for lives of boring work in hierarchical organizations, they're being socialized for lives of play and self-expression. As Richard Arum and Josipa Roksa frostily remark in their *Academically Adrift*:

> If we presume that students are sleeping eight hours a night, which is a generous assumption given their tardiness and at times disheveled appearance in early morning classes, that leaves 85 hours a week for other activities. . . . What is this additional time spent on? It seems to be spent mostly on socializing and recreation.[100]

A week in modern college is a great way to teach students that life *is* a picnic:

> A recent study of University of California undergraduates reported that while students spent thirteen hours a week studying, they also spent twelve hours socializing with friends, eleven hours using computers for fun, six hours watching television, six hours exercising, five hours on hobbies, and three hours on other forms of entertainment.[101]

Grade inflation completes the idyllic package by shielding students from negative feedback. The average GPA is now 3.2.[102] Instead of making students conform and submit, college showers students with acceptance. This doesn't merely fail to prepare students for their future roles; it actively *un*prepares them. College raises students' expectations to unrealistic heights, leaving future employers the chore of dragging graduates back down to earth.

Yes, there's always the "college molds character compared to sitting alone in your basement playing video games" fallback. The relevant alternative, though, is a full-time job—and compared to that, college is a joke. As long as you avoid rare, demanding paths like engineering and premed in college, you bask in the warmth of a four-year vacation. If that's "socialization," it's dysfunctional socialization.

In any case, imagine school and work really were equally effective ways to shape kids' souls to suit the workplace. How effective would that be? Labor economists have spent decades measuring the reward for work experience. A year of experience typically raises income by 2–3%.[103] Some of this payoff has to reflect task-specific learning as opposed to discipline and socialization. Say it's half. Then a year's worth of character building is worth a 1–1.5% raise. Most estimates say a year of education is *many* times more lucrative. Even on generous assumptions, then, discipline and socialization explain a tiny sliver of the education premium.

Who You Know

About half of all workers used contacts—relatives, friends, acquaintances—to land their current job.[104] You could argue that education pays despite "low measured learning" because we're inappropriately measuring *what* you know instead of *who* you know. Perhaps studying is overrated.

Instead, the upwardly mobile student wins friends and influences people. The better your school, the better your connections after graduation.

This story has a kernel of truth and is occasionally dead right. Overall, though, it's weak. The modern economy is vast and diverse. Few of the students you meet will end up in your line of work—even if they share your major. As a result, they'll probably never be in a position to help you. If you're looking for a good job, you don't want generic contacts. You want *relevant* contacts.[105]

Friends in your narrowly defined occupation are quite lucrative.[106] So are older male relatives (father, uncle, grandfather) who know the boss or vouch for you.[107] When researchers estimate the *average* benefit of "contacts" or "social networks," though, some find a positive effect on employment and wages, some no effect, and others a negative effect.[108] If this seems implausible, bear in mind: even if your cousin or college roommate plainly "got you your job," you might have swiftly found as good or better a job on your own.

Who *does* meet useful contacts in school? If you want a job in education, school is the ideal place to network. Once I resolved to become an economics professor, I strove to meet other economics professors. One, Tyler Cowen, got me my job. (I also met many philosophy, history, and law professors. Career payoff so far: zero.) If you're earning a professional degree in law or medicine, or majoring in more vocational subjects like engineering, you and your classmates will plausibly trade career favors down the line. Stanford's computer science program could be your passport to Silicon Valley. At some elite schools, fraternities funnel brothers into finance and consulting.[109] Hell Week could land you on Wall Street. Normally, however, lucrative networking begins *after* students graduate and find a niche in the sprawling modern economy.

The False Promises of Education

> We asked the young people whether they remember having learned something important at school. It seemed to be a difficult question for most. Often the question was followed by long silences and embarrassed laughs.
>
> —Elina Lahelma, "School Is for Meeting Friends"[110]

Education seems to pay. Human capital purism advances a single explanation: education pays because education teaches lots of useful job skills. A tempting story . . . until you stare at what schools teach, what students learn, and what adults know. Then human capital purism looks not just overstated, but Orwellian. *Most* of what schools teach has no value in the labor market. Students fail to learn *most* of what they're taught. Adults forget *most* of what they learn. When you mention these awkward facts, educators speak to you of miracles: studying anything makes you better at everything. Never mind educational psychologists' century of research exposing these so-called miracles as soothing myths.

An optimist could admittedly reframe my summary of the facts. If most of what schools teach has no value in the labor market, then *some* of what schools teach has value. If students fail to learn most of what they're taught, then students learn *some* of what they're taught. If adults forget most of what they learn, then adults remember *some* of what they learn.

Fair enough. Yet the question remains: Can the modest job skills we learn in school explain the extra pay we earn after graduation? The answer hinges on the size of the premium. At least on the surface, modern education seems highly lucrative. Does modest learning genuinely lead to immodest earning? Or are the apparently ample rewards of education a statistical illusion?

CHAPTER 3

The Puzzle Is Real

The Handsome Rewards of Useless Education

The world is full of unemployable experts. If you master all there is to know about the Civil War or *Star Trek*, employers will still scoff that you can't "do anything" with your esoteric knowledge. A tempting inference is that all the useless coursework students endure pays as poorly as any other geeky hobby. Daily life feeds temptation: every unemployed college grad and cashier with a Ph.D. seem like further proof that conventional academic curricula fail the market test.

When you peruse income statistics, however, you behold a starkly different picture. As individuals' schooling rises, so does their pay. The earnings gap is enormous. In 2011, holders of advanced degrees made almost *three* times as much as high school dropouts. Each step up the educational ladder seems to count. A high school diploma may sound unworthy of mention in our Information Age, but high school graduates out-earn dropouts by 30%.[1] The numbers come straight from the Census Bureau. Check out Table 3.1 to see the pattern for full-time, year-round adult workers.

Table 3.1: Average Earnings by Educational Attainment (2011)

	Some High School	High School Graduate	Bachelor's Degree	Master's Degree
Average $ Earnings	31,201	40,634	70,459	90,265
Premium over H.S.	−23%	+0%	+73%	+122%

Source: United States Census Bureau 2012a.

These stats are solid, but what do they mean? Mainstream defenders of education tend to take the numbers at face value. Since college grads earn 73% more than high school grads, expect a 73% raise when you finish college. Contrarian detractors of education tend to take the numbers at *no* value. For all we know, college grads would have made 73%