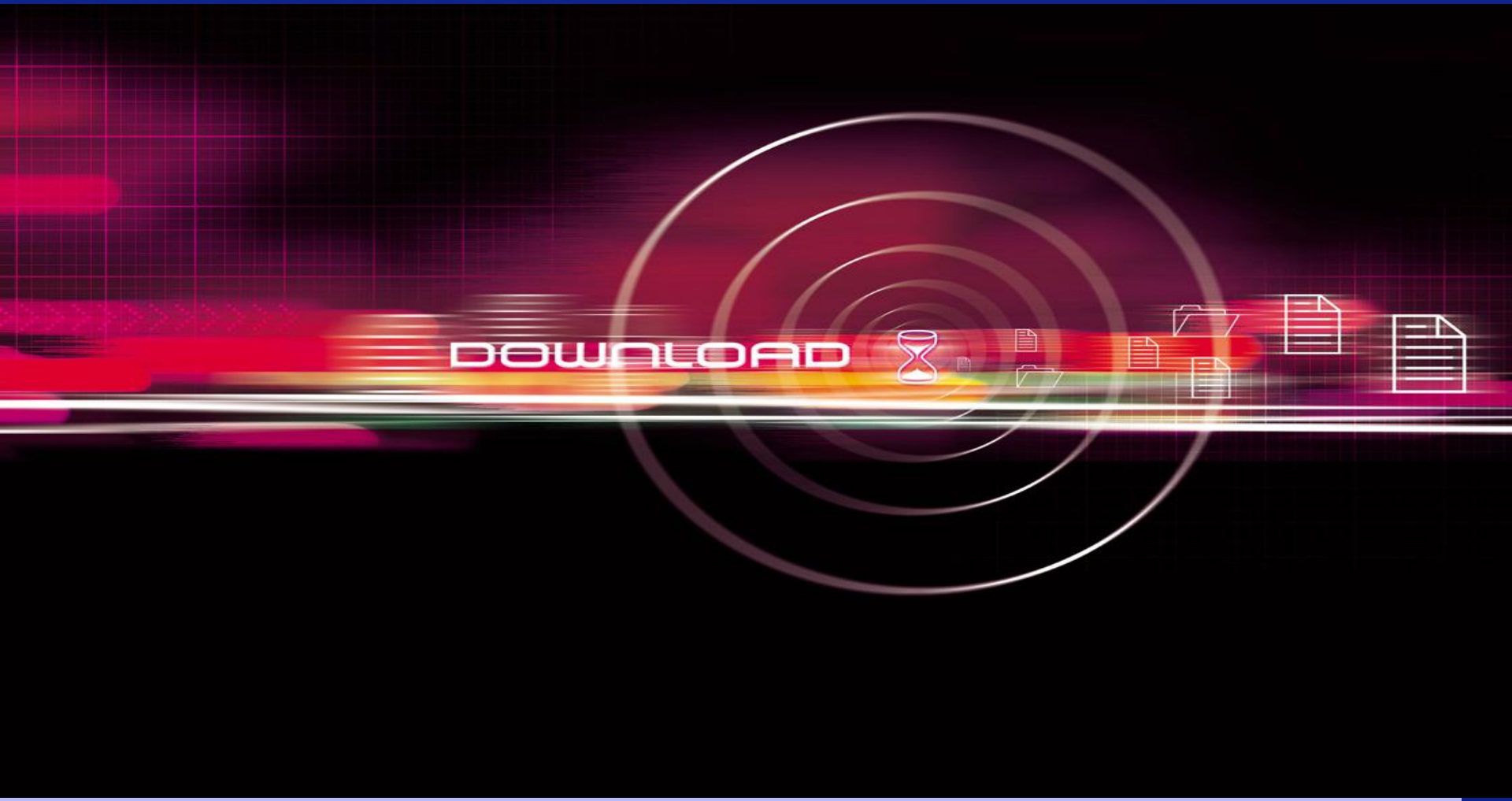
Craig D. Jerald, Break the Curve Consulting
NSBA 2009 Federal Relations Conference
Washington, DC □ February 1, 2009

Preparing Students for the 21st Century

I. How is the world changing?



Forces changing skill demands

- Automation
- Globalization
- Workplace change
- Demographic change
- Personal risk and responsibility

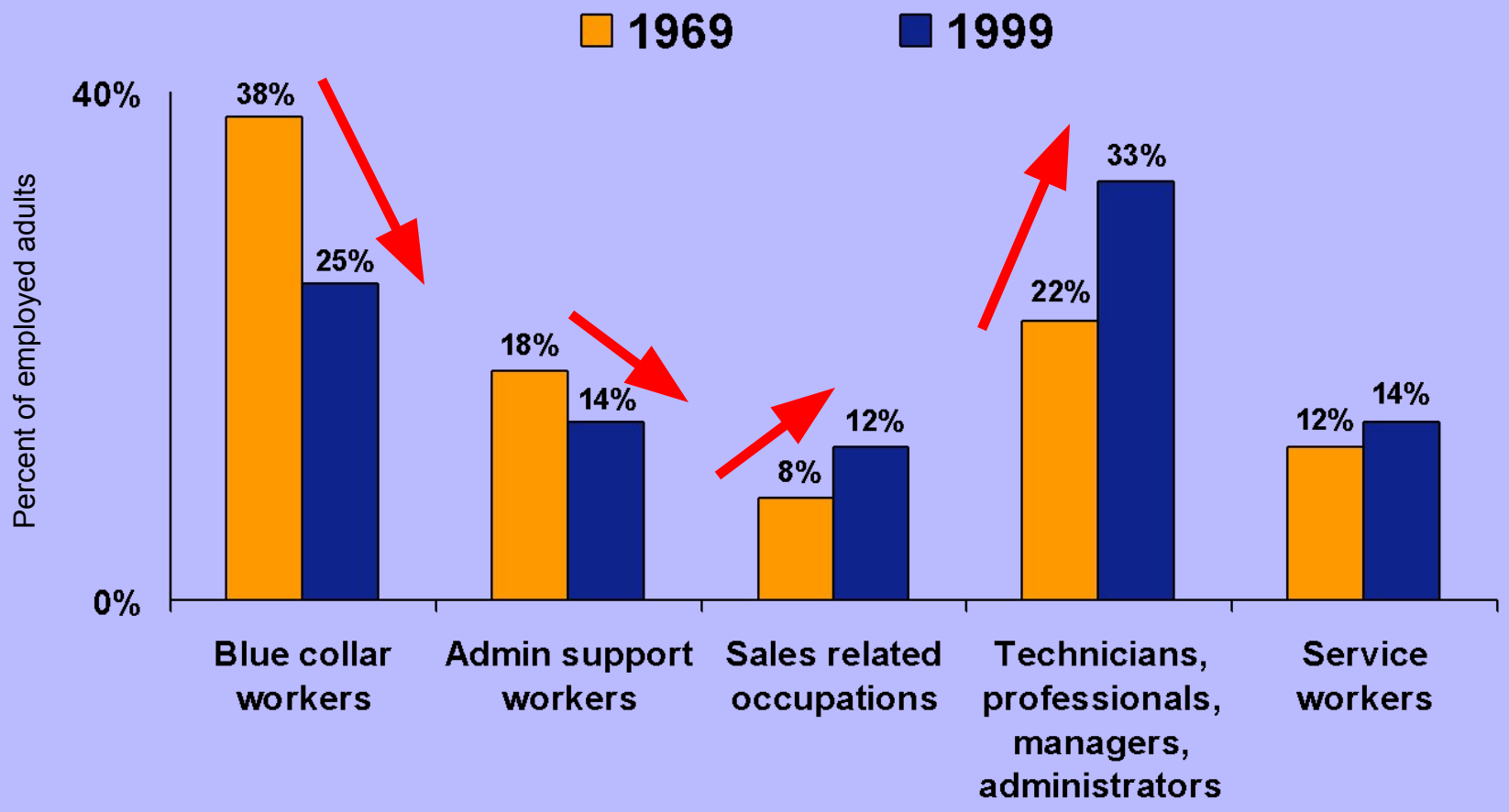
Automation

What kinds of work can computers do?

- **Follow routine directions: Any job where information can be digitized and key tasks can be broken down into a set of predictable rules.**
  - **EG, Airline reservations, tickets, boarding passes. Now you can complete the whole process without ever talking to a human being!**

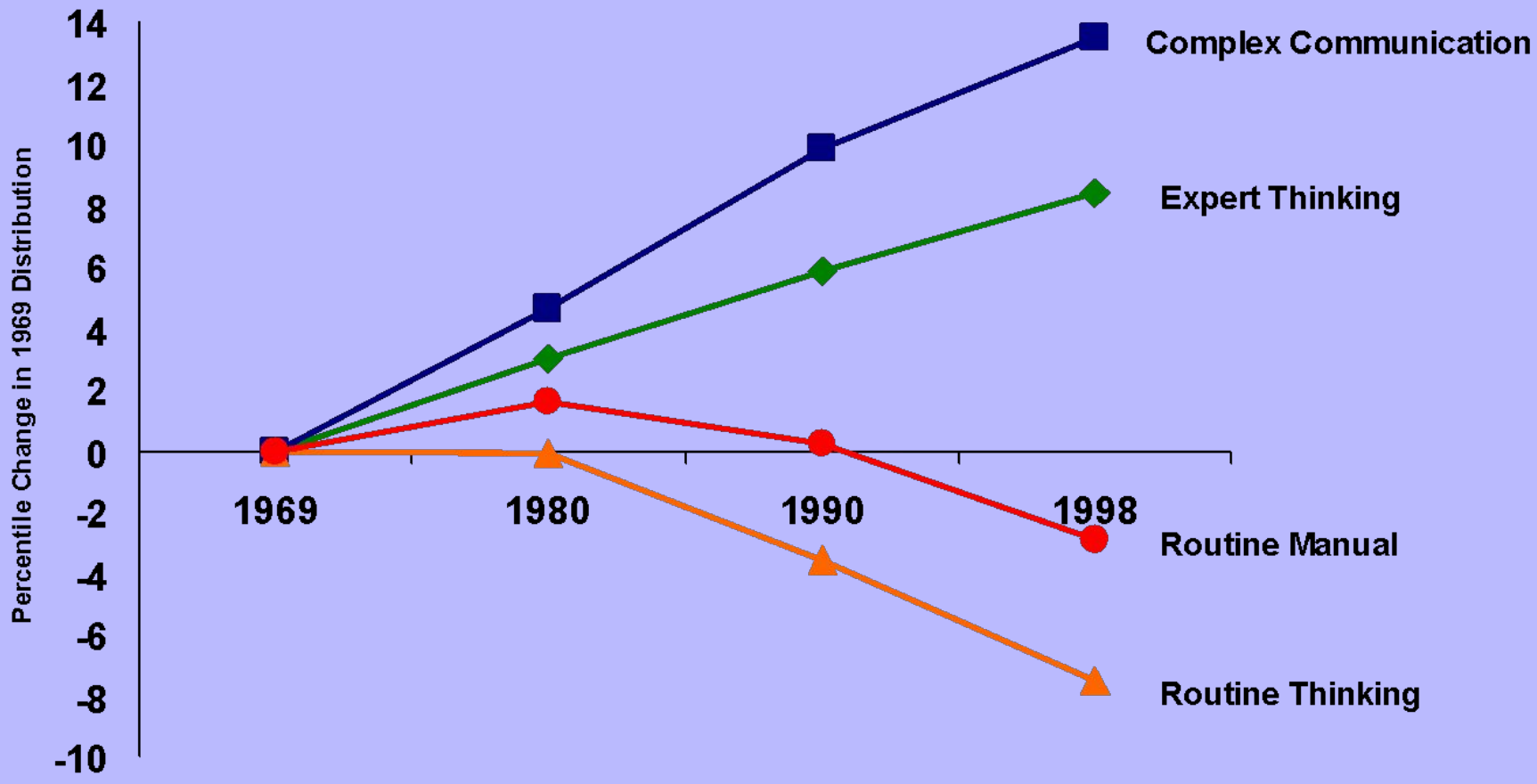
- **Recognize simple patterns.**
  - **EG, On the telephone, recognizing simple sentences in response to prompts, then providing the appropriate information or connecting to the appropriate human.**

Changing mix of jobs in the economy



Source: Levy, F. & Murnane, R. J. (2004). *The new division of labor: How computers are creating the next job market*. Princeton, NJ: Russell Sage Foundation. (p. 42, Figure 3.2)

Job tasks are changing across the economy



Source: Levy, F. & Murnane, R. J. (2004). *The new division of labor: How computers are creating the next job market.* Princeton, NJ: Russell Sage Foundation. (p. 50, Figure 3.5)

What kinds of work *can't* computers do (yet)?

- **Non-routine manual labor:**
  - **EG, driving a truck, security guard, etc.**

- **Non-routine thinking work:**
  - **"Expert Thinking"—The ability to solve unexpected problems for which there are no predictable and programmable rule-based solutions.**
  - **"Complex Communications"—Interacting with other people to acquire information, explain it, or persuade with it.**
  - **Doing both well also requires creativity, which computers also are not very good at.**

Automation has big consequences for education

- Computers can follow directions better, faster, and cheaper than human beings, and the number of tasks computers can do grows every year.
- Any curriculum that emphasizes following directions to find a single correct answer is, by definition, preparing students for jobs that probably will not exist by the time those students graduate.

"To educate our children to compete with either a computer [is to educate them for] a competition they cannot win."

—Frank Levy and Richard Murnane (2007)

Globalization

Work can increasingly be done anywhere … and there are more workers who can do it!

- **Technological advances (internet, interactive software, digital technologies) allow work to be carved up and shipped around globe.**
- **Historic political and economic changes around the globe freed up more than 1 billion people—in places like Russia, Eastern Europe, China, India, etc.—who could potentially compete for that work.**

"The result is a world in which it is just as easy to create work teams composed of people on four continents as it is to create work teams composed of people from four divisions of the same firm located in the same city."

—the New Commission on the Skills of the American workforce (2007)

Implications for your students

"Suddenly more people from more different places could collaborate with more other people on more different kinds of work and share more different kinds of knowledge than ever before."

—Thomas Friedman (2005)

"Highly skilled people with roughly the same qualifications are competing directly with each other, no matter where they are located on the globe."

—the New Commission on the Skills of the American workforce (2007)

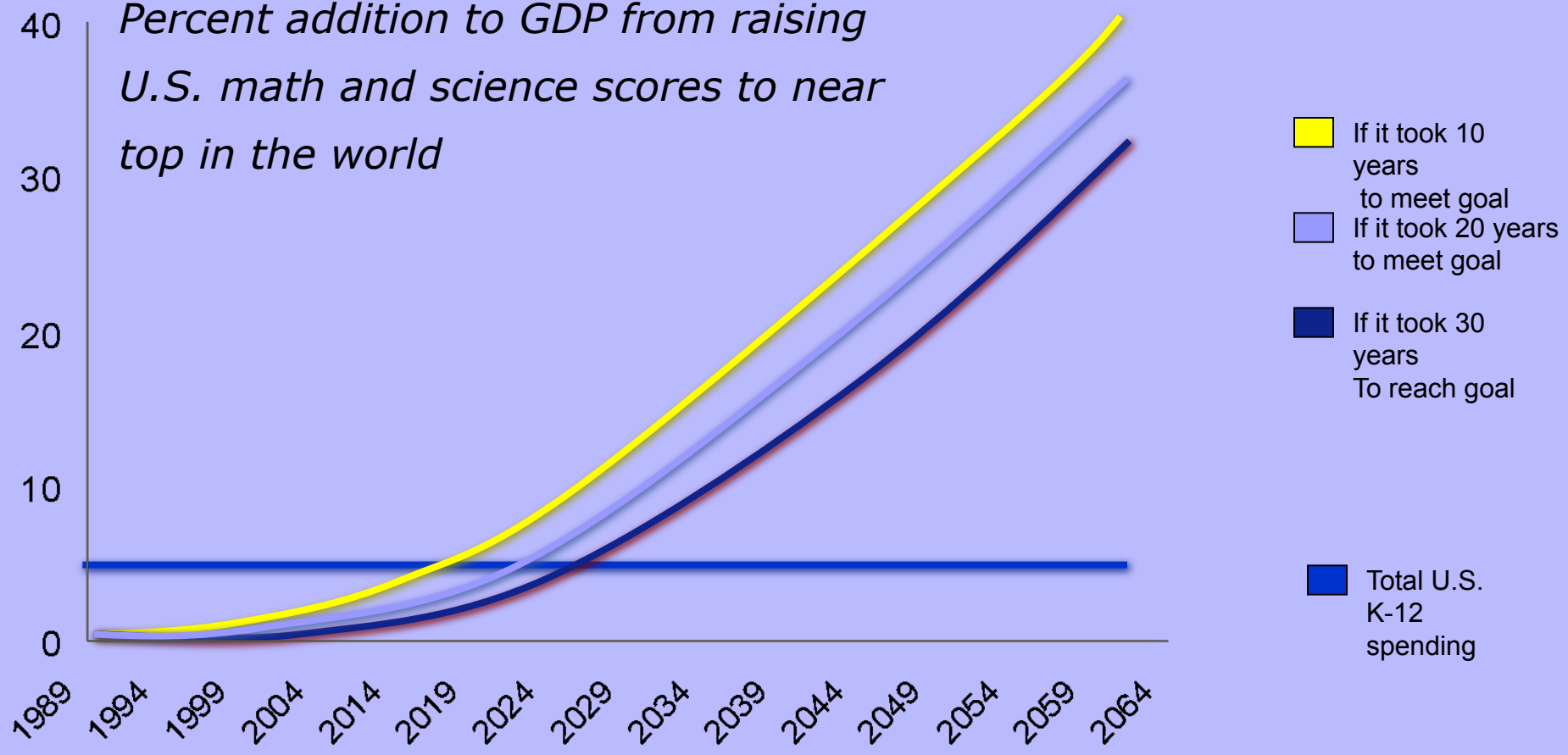
Sources: 1) National Center on Education and the Economy. (2007). *Tough choices or tough times: The report of the New Commission on the Skills of the American workforce*. San Francisco, CA: Jossey-Bass. (p. 19)
2) Friedman, T. L. (2005). *The world is flat: A brief history of the twenty-first century*. New York: Farrar, Straus and Giroux. (p. 81)

National implications, too: Human capital has a big impact on economic growth

- **If the U.S. improved students' performance on international tests to the level of top performing nations, its Gross Domestic Product (GDP) would be:**
  - **An additional 5 percent higher 32 years from now (enough to entirely pay for K-12 education), and**
  - **An additional 36 percent higher 75 years from now!**

Source: Hanushek, E. A. & Woessmann, L. (2008, September). The role of cognitive skills in economic development. *Journal of Economic Literature, 46*(3), 607–68. (p. 650)

Impact of higher math & science scores on economic growth, projections through 2064



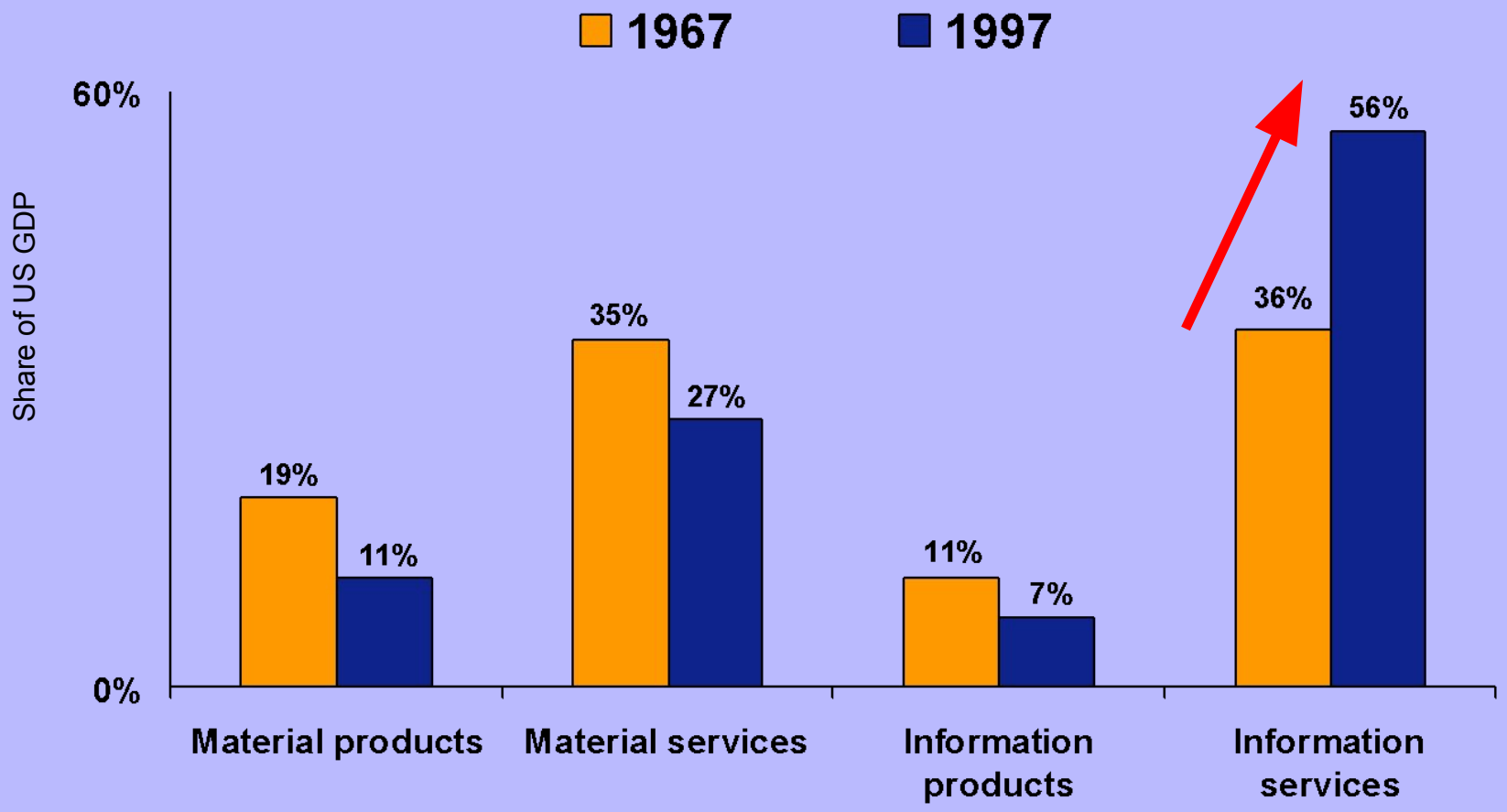
NOTE: "K-12 education expenditures are assumed to be constant at the level attained in 2005. These data show that economic benefits from a 1989 reform that raised the U.S. to the highest levels of test performance would cover the cost of K-12 education by 2015."
Source: Hanushek, E. A., et al. (2008, Spring). Education and economic growth. *Education Next, 8*(2), 62-70. (p. 69)

Workplace change

Major shifts in the workplace

- Companies focusing more on providing information than “things.”
- Companies are “flatter,” with less hierarchy and less direct supervision.
- Employees have more autonomy and responsibility.
- Work is much more collaborative.
- Jobs are less routine, predictable, and stable.

Growth of the information-service economy



Source: Apte, U. M., Karmarkar, U. S., & Nath, H. K. (2008, Spring). Information services in the U.S. economy: Value, jobs, and management implications. *California Management Review, 50*(3), 12-30.(p. 18, Table I)

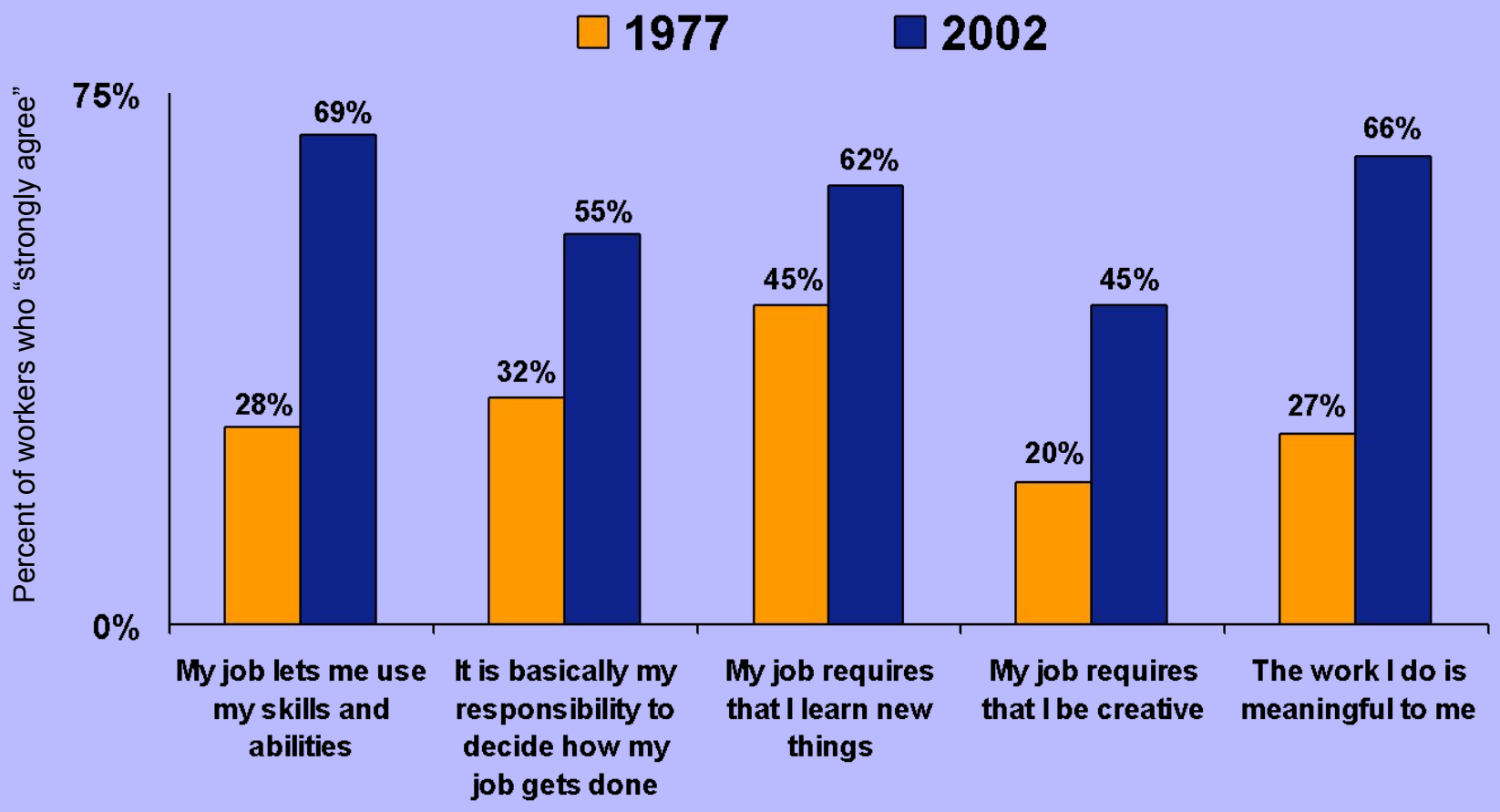
More collaboration in the workplace

In top 1,000 companies:

Use of self-managing work teams rose from 28% in 1988 to 65% in 2005.

Work teams are increasingly *global*.

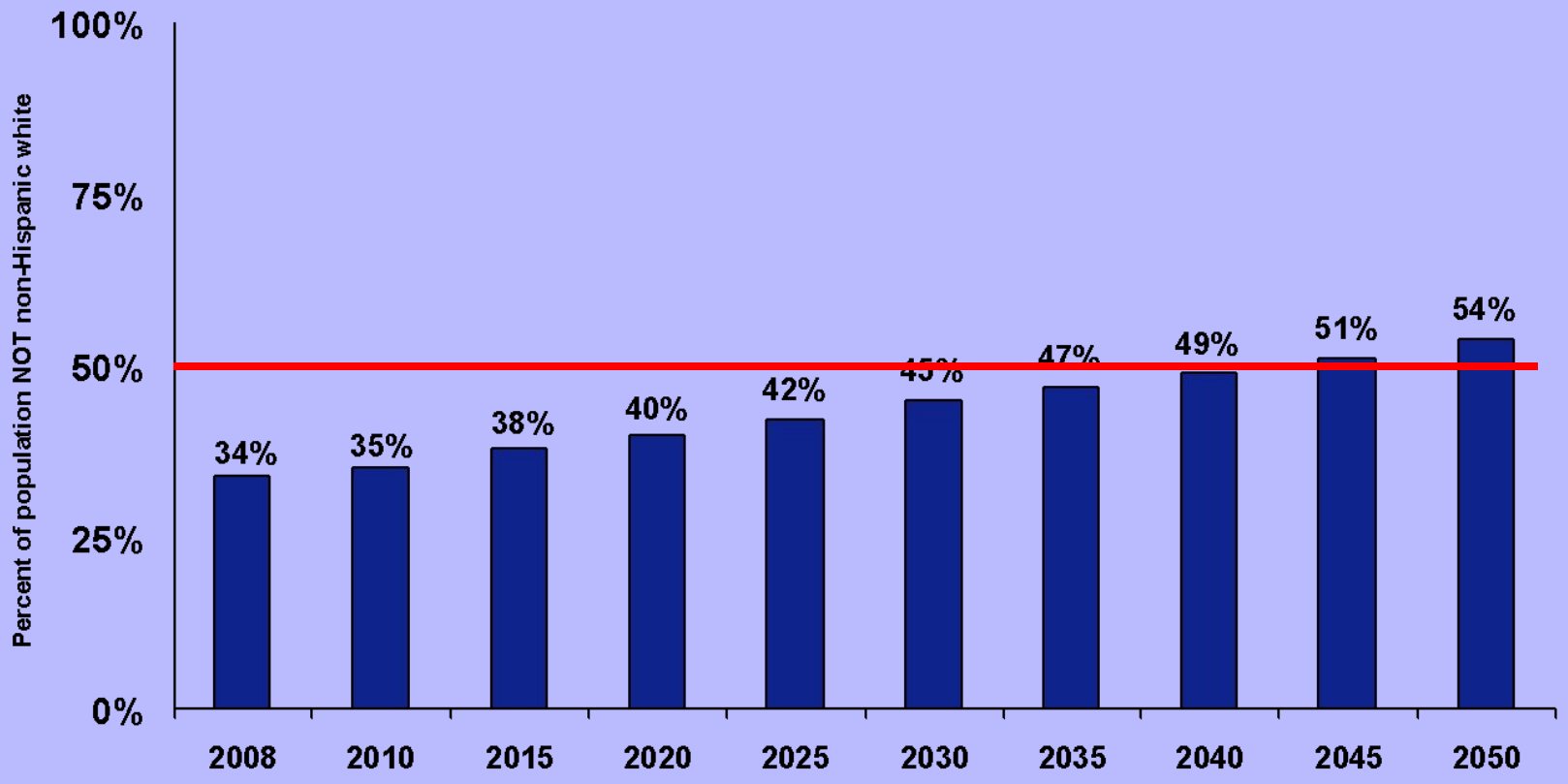
Work has become more challenging … and more satisfying



Source: O'Toole, J. & Lawler, E.E. III. (2006). *The new American workplace*. New York: Palgrave Macmillan. (p. 55)

Demographic change

A more diverse population: "Minorities" will be U.S. majority in about 30 Years



Source: Census Bureau. (2008, August 14). *An older and more diverse nation by mid-century*. Washington, DC: U.S. Department of Labor. (Table 3: Projections of the Population by Race and Hispanic Origin for the United States 2008 to 2050)

More diverse population

Year in which "minorities" will become the majority of …

- **Entire U.S. population = 2042**
- **Working-age population = 2039**
- **School-age population = 2023**

Source: Census Bureau. (2008, August 14). *An older and more diverse nation by mid-century*. Washington, DC: U.S. Department of Labor.

More diverse population

Implications:

- **Schools will need to be able to educate a more diverse student population**

- **Schools will need to prepare students to interact in a more diverse society and collaborate in a more diverse work environment**

  - **More diverse U.S. society, which will be reflected in the workplace, but also …**

  - **International collaboration, global work teams**

Aging population

- **By the time the last Baby Boomer reaches 65 in 2030, nearly one out of five U.S. residents will be 65 or older.**
- **Between 2008 and 2050 …**
  - **The 65 and older population will DOUBLE**
  - **The 85 and older population will TRIPLE**

Source: Census Bureau. (2008, August 14). *An older and more diverse nation by mid-century*. Washington, DC: U.S. Department of Labor.

"Fewer of us will have to support many more of us than has ever been the case before."

Source: National Center on Education and the Economy. (2007). *Tough choices or tough times: The report of the New Commission on the Skills of the American workforce*. San Francisco, CA: Jossey-Bass. (p. 7).

Personal risk and responsibility

Shift in corporate benefit policies

Individuals now shoulder more responsibility for personal well-being:

- **Job security:** ***employment more contingent on performance than loyalty***
- **Financial planning:** ***more 401(k)s, fewer defined-benefit plans***
- **Health care:** ***consumers increasingly called on to choose own coverage & care***

Employment is less secure: Those who cannot perform will not keep their jobs

Source: O'Toole, J. & Lawler, E.E. III. (2006). *The new American workplace*. New York: Palgrave Macmillan. (p. 67)

Retirement coverage is shifting toward individually controlled investments

Pension plans with investments controlled by employers are being replaced by IRAs and 401(k)s that require individuals to make at least some investment decisions.

Retirement was once something that workers did not have to think a lot about. Today, they do have to think about it, and how well they think about can have huge consequences for their future well-being.

Consumers are asked to make own decisions about health care and costs

- **Health coverage choices are more complicated and varied**
- **Information about the quality of health care providers and treatment effectiveness is more transparent and accessible**

"Consumers therefore require more knowledge and greater skill to take full advantage of new sources of information and to make appropriate choices."

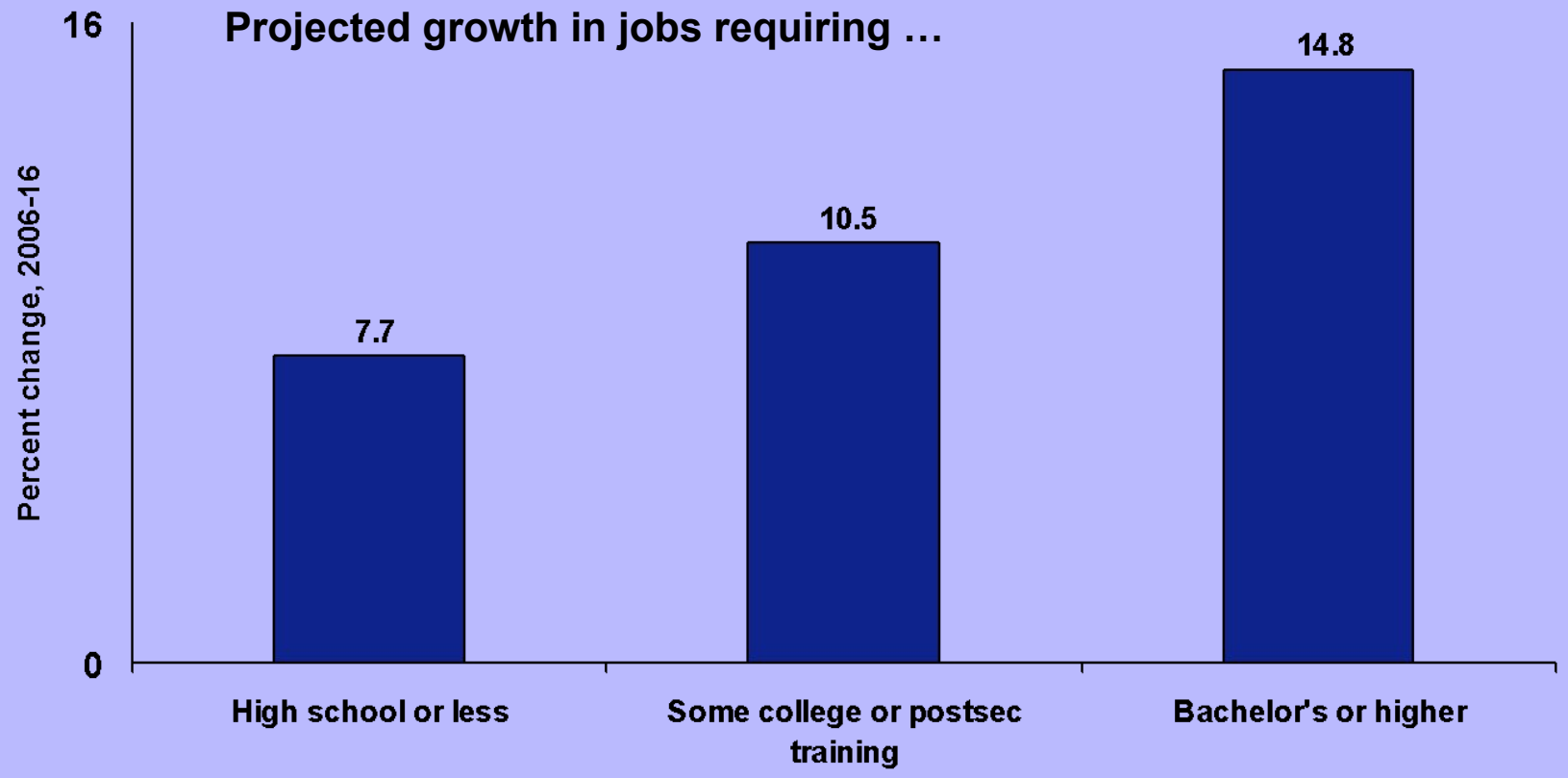
Hibbard, Peters, Dixon & Tusler
Consumer competencies and the use of comparative quality information, 2007

II. What kind of knowledge and skills will young people need?

More important in the 21st Century

- Postsecondary education and training
- Academic knowledge and skills
- Practical literacies: The ability to use knowledge of math, English, science, civics etc. to meet real-world challenges.
- Broader competencies: Critical thinking and problem solving, communications and collaboration, creativity, self-sufficiency etc.

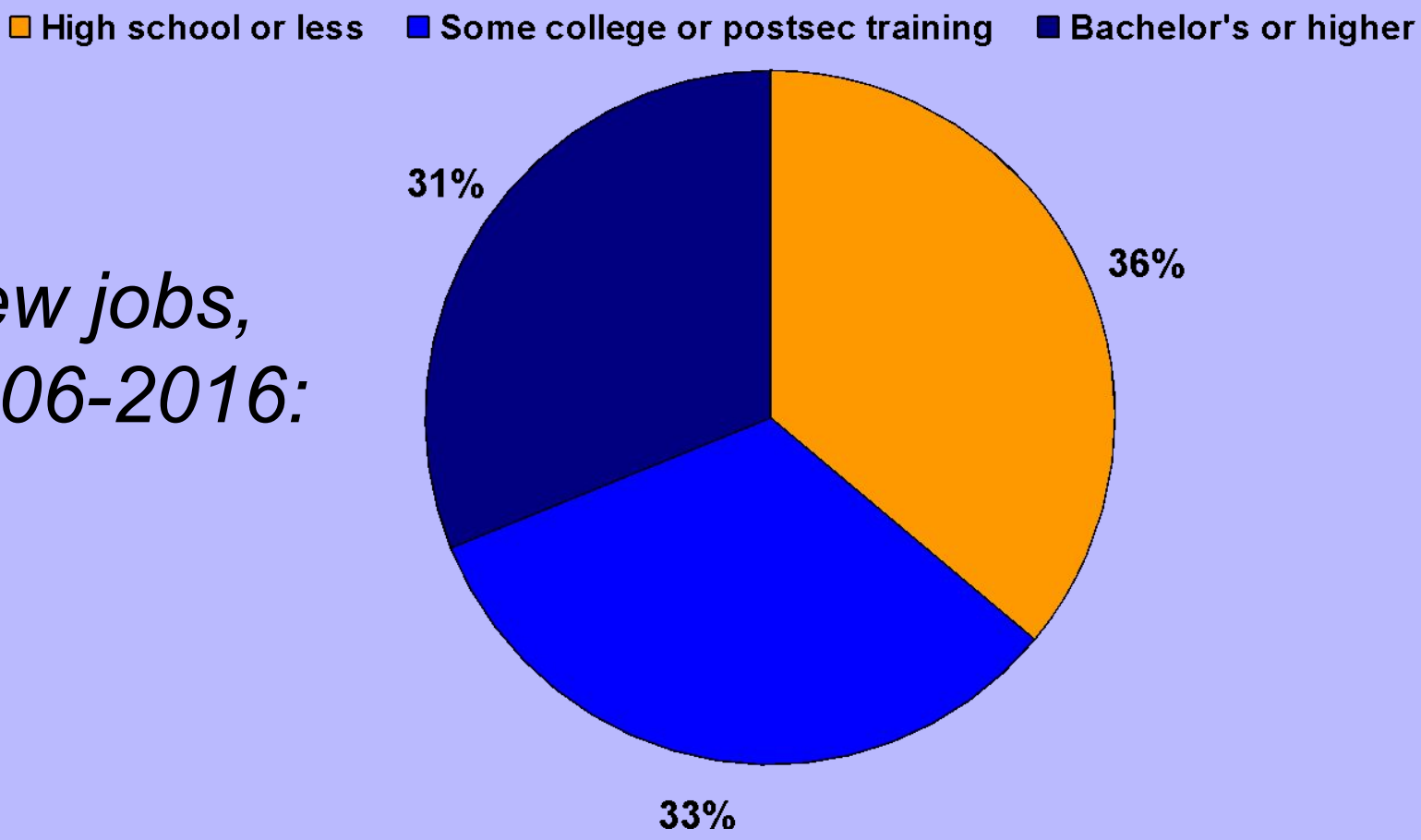
Occupations requiring more education are predicted to grow faster



Source: Bureau of Labor Statistics. (2008, February). *Occupational projections and training data: 2008-9 edition*. Washington, DC: U.S. Department of Labor. (p. 4, Table I-3)

Nearly two-thirds of new jobs will require postsecondary education or training

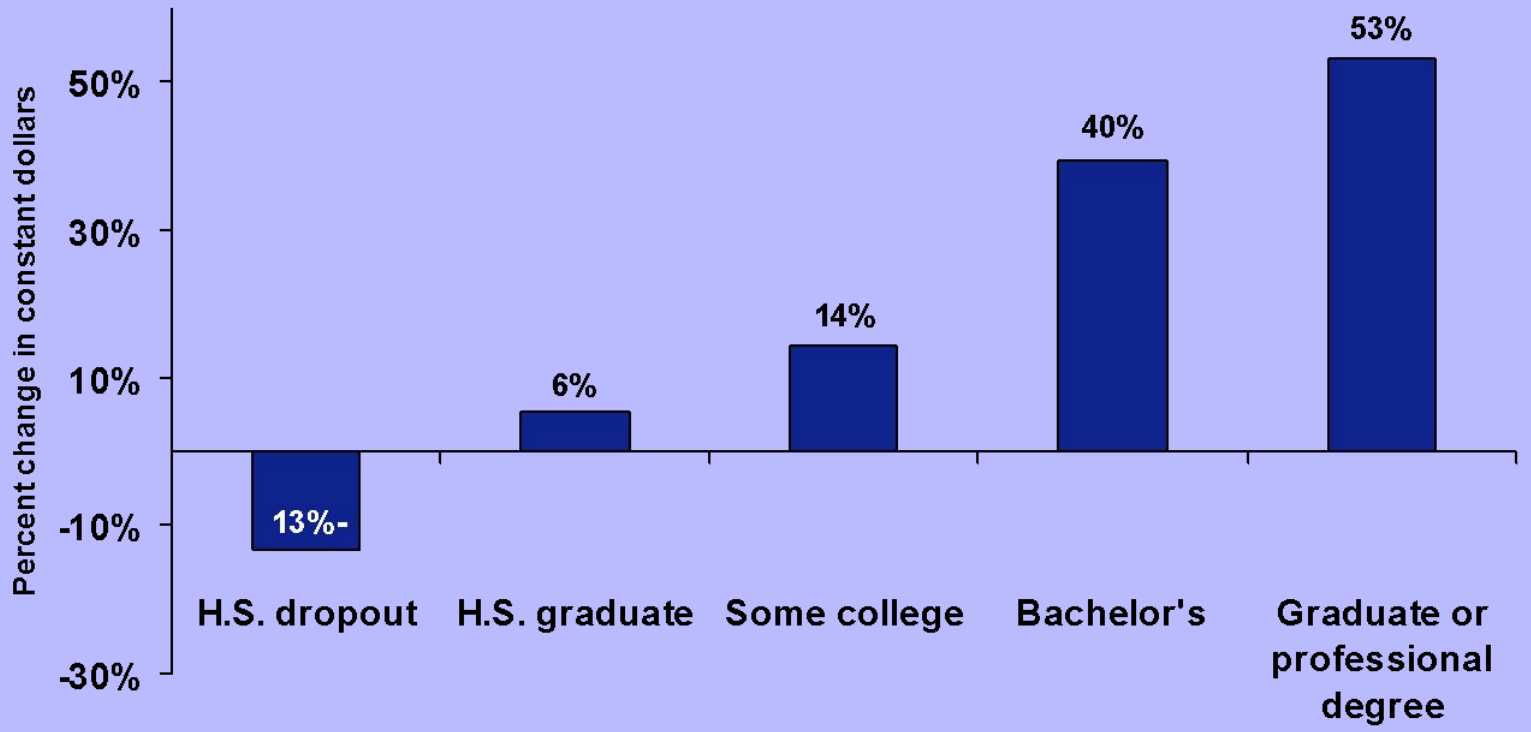
New jobs, 2006-2016:



Source: Bureau of Labor Statistics. (2008, February). *Occupational projections and training data: 2008-9 edition*. Washington, DC: U.S. Department of Labor. (p. 4, Table I-3)

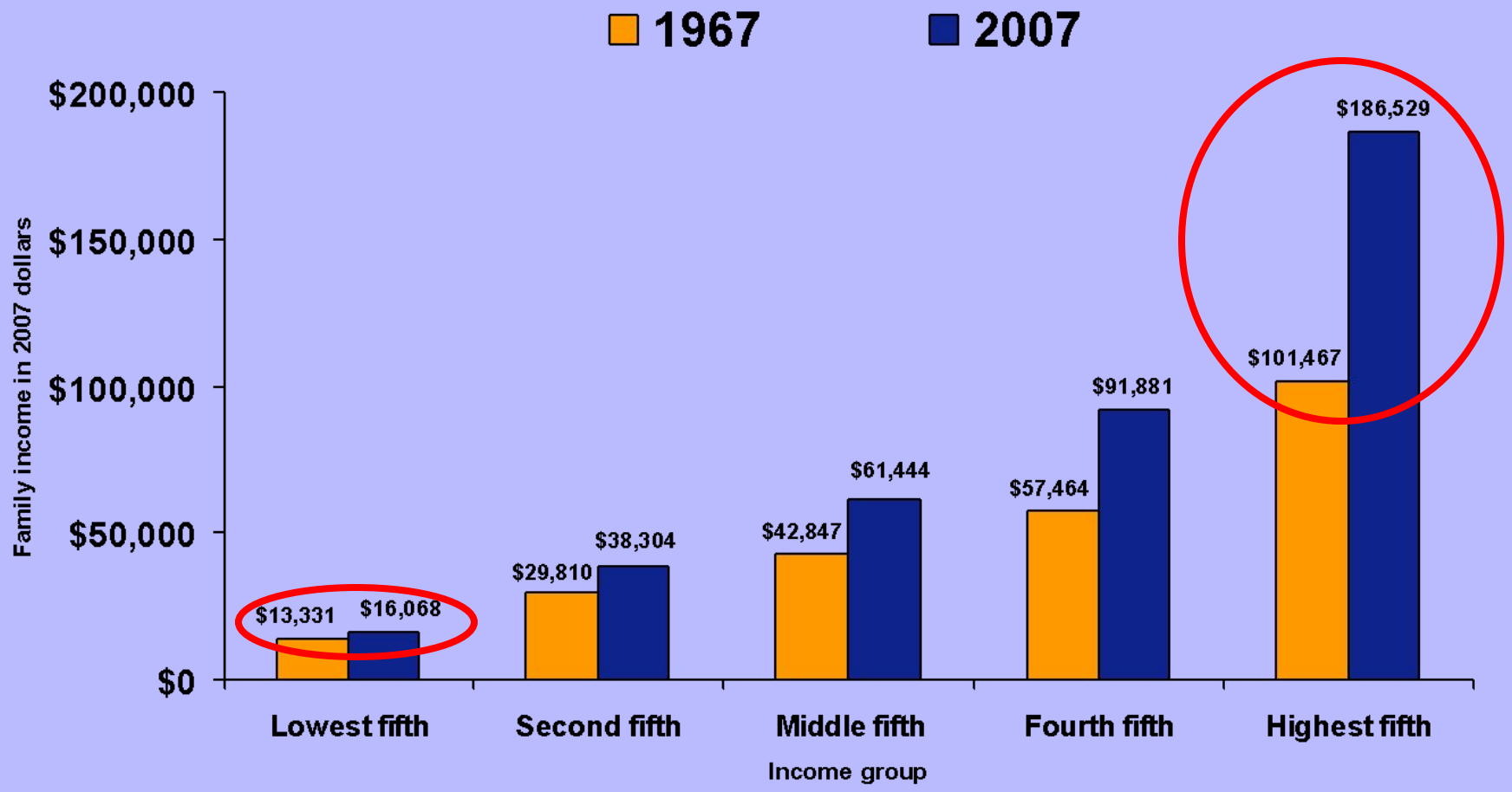
Earnings boost for college degree has grown immensely

Change in average family income from 1973 to 2006:



Source: Mortenson, T. (2007, November). Average family income by educational attainment of householder 1967 to 2006. *Postsecondary Education Opportunity, 185.* (p. 15)

Income inequality has increased massively over last 40 years driven by demand for high-skilled workers

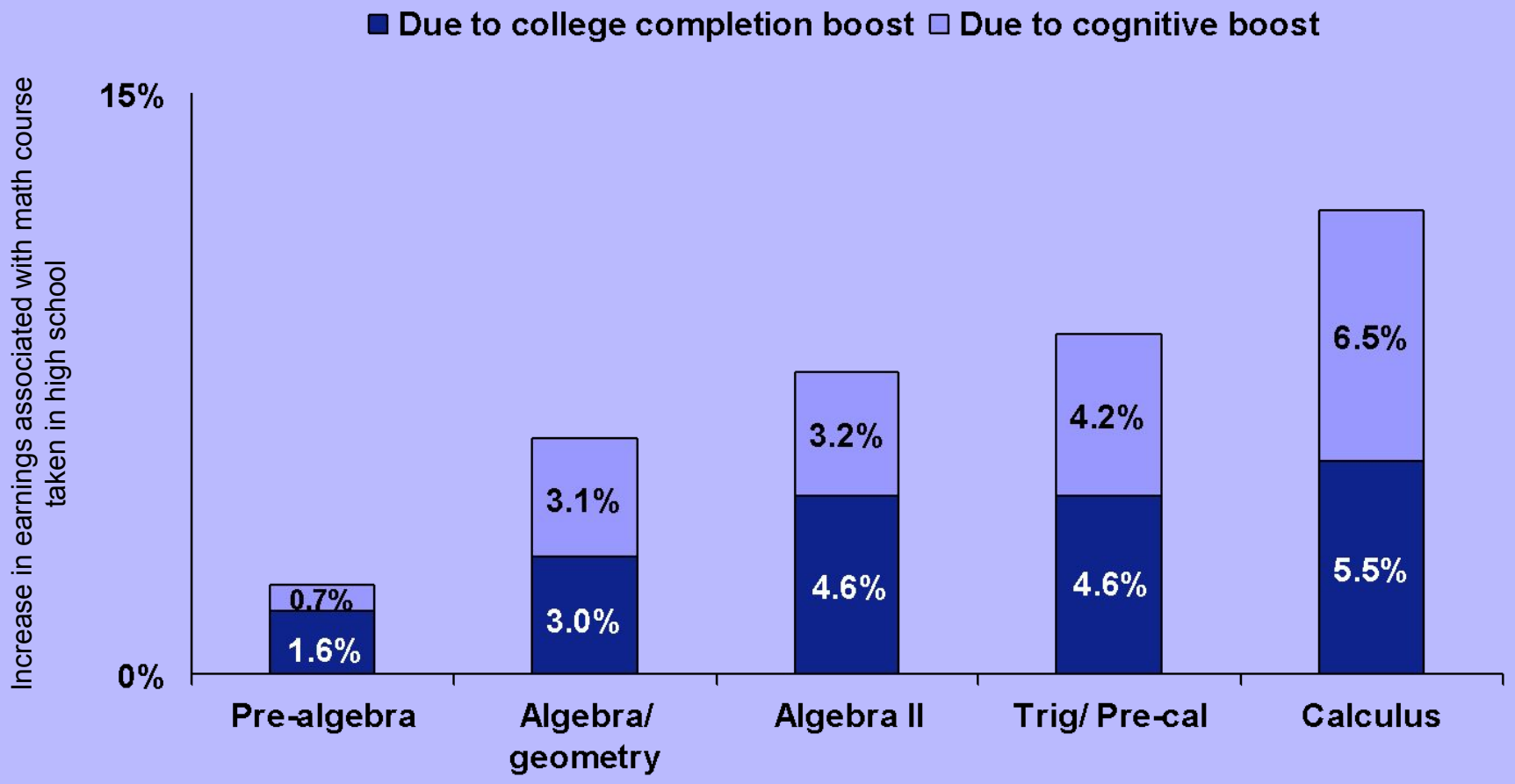


Source: U.S. Census Bureau, Historical Income Tables - Families, Table F-3 Mean Income Received by Each Fifth and Top 5 Percent of Families, All Races: 1966 to 2007, http://www.census.gov/hhes/www/income/histinc/f03AR.html

Academics count: Preparing students for college and work

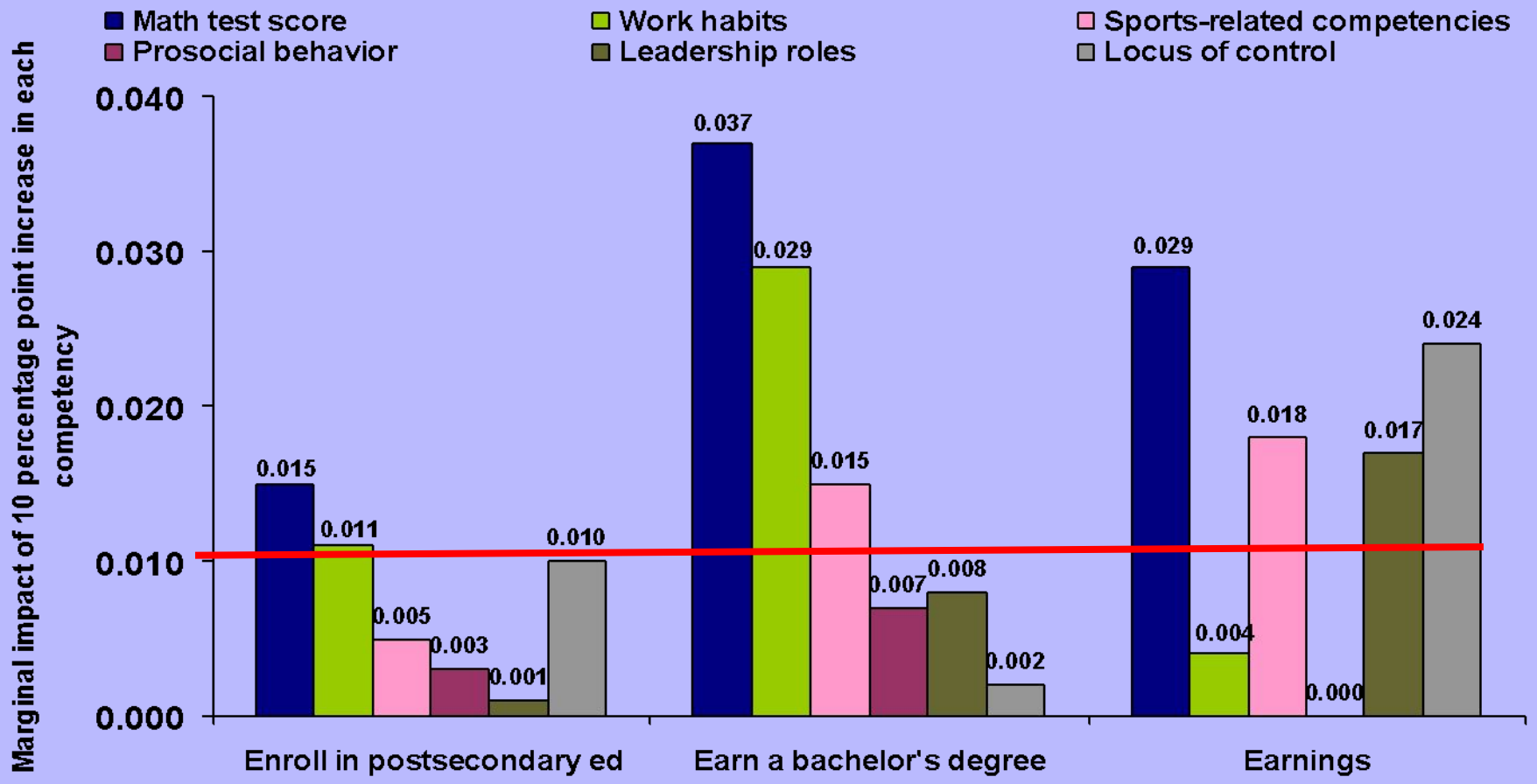
- **Completing advanced math courses in high school has a greater influence on whether students will graduate from college than any other factor, including family background; students who take math beyond Algebra II double their chances of earning a bachelor's degree.**
- **Just taking advanced math has a direct impact on future earnings, apart from any other factors; students who take advanced math have higher incomes ten years after graduating—regardless of family background, classroom grades, and college degrees.**
- **Recent studies suggest that higher math skills at the end of high school* translates into a 12 percent boost in wages. (* Scoring one standard deviation higher on a standardized math test.)**

Advanced math improves earnings



Source: Rose, H. & Betts, J. R. (2004, May). The effect of high school courses on earnings. *The Review of Economics and Statistics, 86*(2), 497-513. Based on data in Table 2 on p. 501.

Math skills are more consistently related to postsecondary success than other competencies



Source: Deke, D. & Haimson, J. (2006, September 15). *Valuing student competencies: Which ones predict postsecondary educational attainment and earnings, and for whom?* Princeton, NJ: Mathematica Policy Research, Inc. (p. 21, TABLE IV.1)

NOTE: Only the values at or above the **red line** were statistically significant.

The screening test for electrician apprenticeships

Sample Algebra and Functions

This is a test of your ability to solve problems using algebra.

1. Consider the following formula: A = B + 3 (4 - C)
If B equals *5* and C equals 2, what is the value of A?

A.7
B.11
C.12
D.17

2. Consider the following formula: y = 3 (x + 5) (x - 2)
Which of the following formulas is equivalent to this one?

A. y=3x2+9x-30
B. y=x2+3x-lO
C. y=3x2+3x-lO
D. y=3x2+3x-30

3. Consider the following pattern of numbers: 110, 112, 107, 109, 104
What is the next number in the pattern?

A.97
B. 99
C. 106
D.109

4. Consider the following formula: a = 1/2 b - 4
Which of the following statements is true for this formula?

A. When the value of *b* is less than 8, a is negative.
B. When the value of *b* is greater than 8, a is negative.
C. When the value of *b* is less than 8, a is positive.
D. When the value of *b* is greater than 4, a is positive.

Source: National Joint Apprenticeship and Training Committee for the Electrical Construction and Maintenance Industry, http://www.njatc.org/training/apprenticeship/index.aspx

Trades becoming more technical, requiring stronger math & reading

"Don't be influenced by those who see the electrical construction trade as an occupation requiring only a strong back and a weak mind. The electrical trades are becoming more technical each day."

—Website of the Electrical Training Institute of Southern California

"If you want to work in the real world, if you want to wire buildings and plumb buildings, that's when it requires algebra."

—Don Davis, executive director of the Electrical Training Institute of Southern California (*Los Angeles Times*, January 30, 2006)

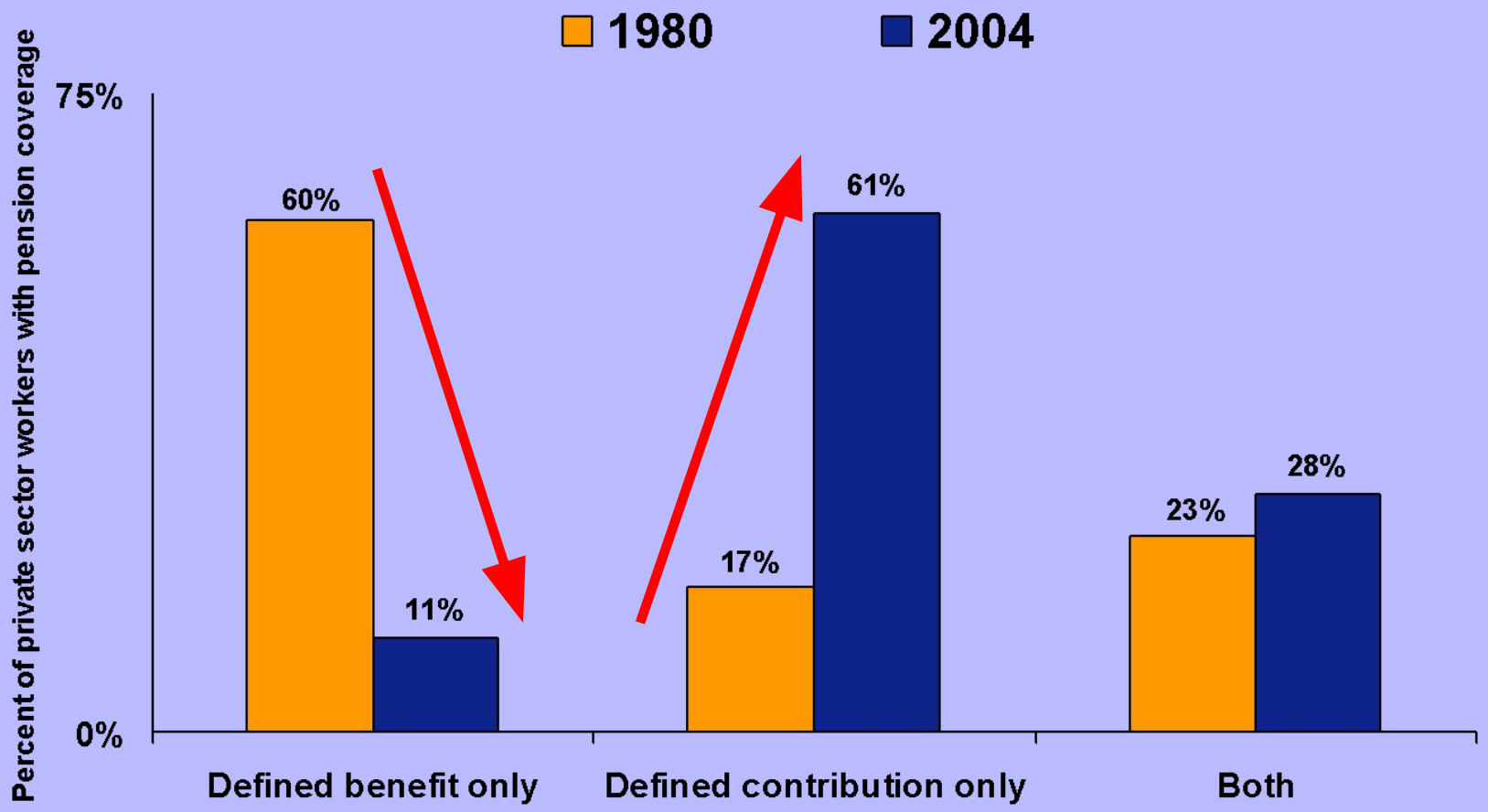
Trades becoming more technical, requiring stronger math & reading

ACT Study: The math and reading skills required for electricians, construction workers, upholsterers, and plumbers same as what's necessary to succeed in first-year college courses!

ACT, Readiness for College and Readiness for Work: Same or Different, Iowa City, IA. 2006

… but those skills are also increasingly important OUTSIDE of jobs!

Financial planning: Major shift in retirement coverage



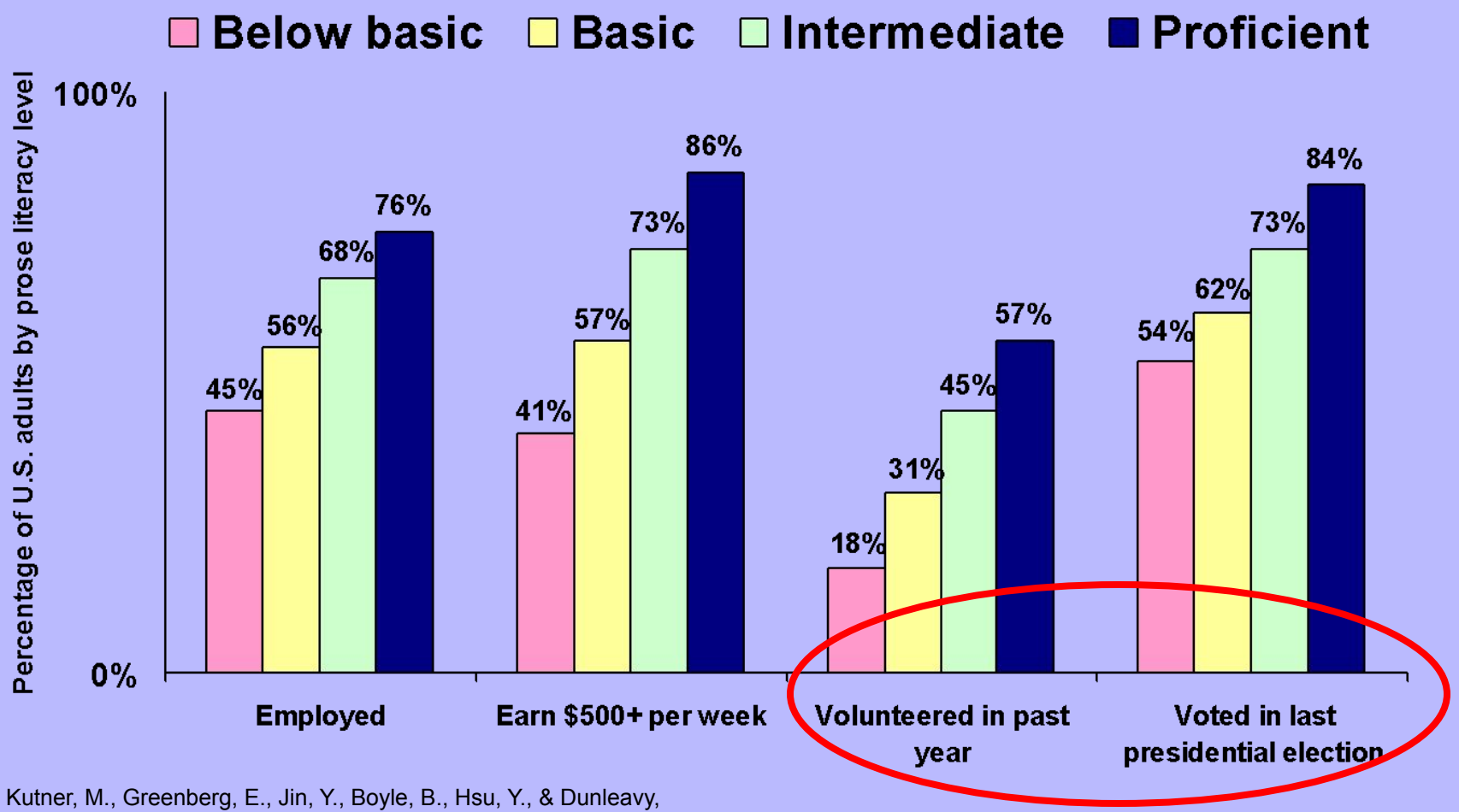
Source: Munnell, A. H., Haverstick, K., & Sanzenbacher, G. (2006, October). *Job tenure and the spread of 401(k)s.* Boston, MA: Center for Retirement Research at Boston College. (p. 1, Figure 1)

Health care: Numeracy matters

Patients with lower math literacy:

- **Have worse understanding of risks and make worse decisions about the benefits of mammography and experimental cancer treatments ;**
- **Have a harder time taking prescribed medications (inhaled steroids, anticoagulation drugs) and as a result worse health outcomes and more hospitalizations ;**
- **Have a harder time comprehending nutrition labels important for patients with chronic illnesses like hypertension and diabetes ;**
- **Have a harder time comprehending information about health coverage options and make less informed choices about health plans ; and**
- **Choose lower quality hospitals than more numerate patients when given the same information on medical outcomes.**

Stronger literacy, more job success and more civic engagement!



Source: Kutner, M., Greenberg, E., Jin, Y., Boyle, B., Hsu, Y., & Dunleavy, E. (2007). *Literacy in everyday life: Results from the 2003 National Assessment of Adult Literacy*. Washington, DC: U.S. Department of Education.

Broad competencies: Employers expect them to become more important

Source: Conference Board. (2006). *Are they really ready to work?* (p. 49, Table 12)

Broad Competencies: Which are most critical? The 3 C's!

- Critical thinking and problem solving
  - Labor economists Levy & Murnane call it "expert thinking"
- Communication/Collaboration
  - Levy and Murnane call it "complex communications"
- Creativity

Solve This Problem

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?

Critical Thinking & Problem Solving: Important for high school grads entering workforce

- **Nearly 60% of employers rate critical thinking and problem solving as "very important" for h.s. grads entering the workforce … yet 70% of employers rate them "deficient" in those skills.**
- **While 73% of school superintendents think h.s. grads meet expectations for "problem solving," only 45% percent of employers think so.**
- **78% of employers expect critical thinking/problem solving to become even more important in the near future.**

Sources: 1) Conference Board. (2006, October). *Are they really ready to work?* New York: Author. (p. 21, Table 3 and p. 32, Table 6)
2) Conference Board. (2008, March). *Ready to innovate: Are educators and executives aligned on the creative readiness of the U.S. workforce?* New York: Author.

Here's another problem

A small country was ruled from a strong fortress by a dictator. The fortress was situated in the middle of the country, surrounded by farms and villages. Many roads led to the fortress through the countryside. A rebel general vowed to capture the fortress. The general knew that an attack by his entire army would capture the fortress. He gathered his army at the head of one of the roads, ready to launch a full-scale direct attack.

However, the general then learned that the dictator had planted mines on each of the roads. The mines were set so that small bodies of men could pass over them safely, since the dictator needed to move his troops and workers to and from the fortress. However, any large force would detonate the mines. Not only would this blow up the road, but it would also destroy many neighboring villages. It therefore seemed impossible to capture the fortress.

Did you see the pattern?

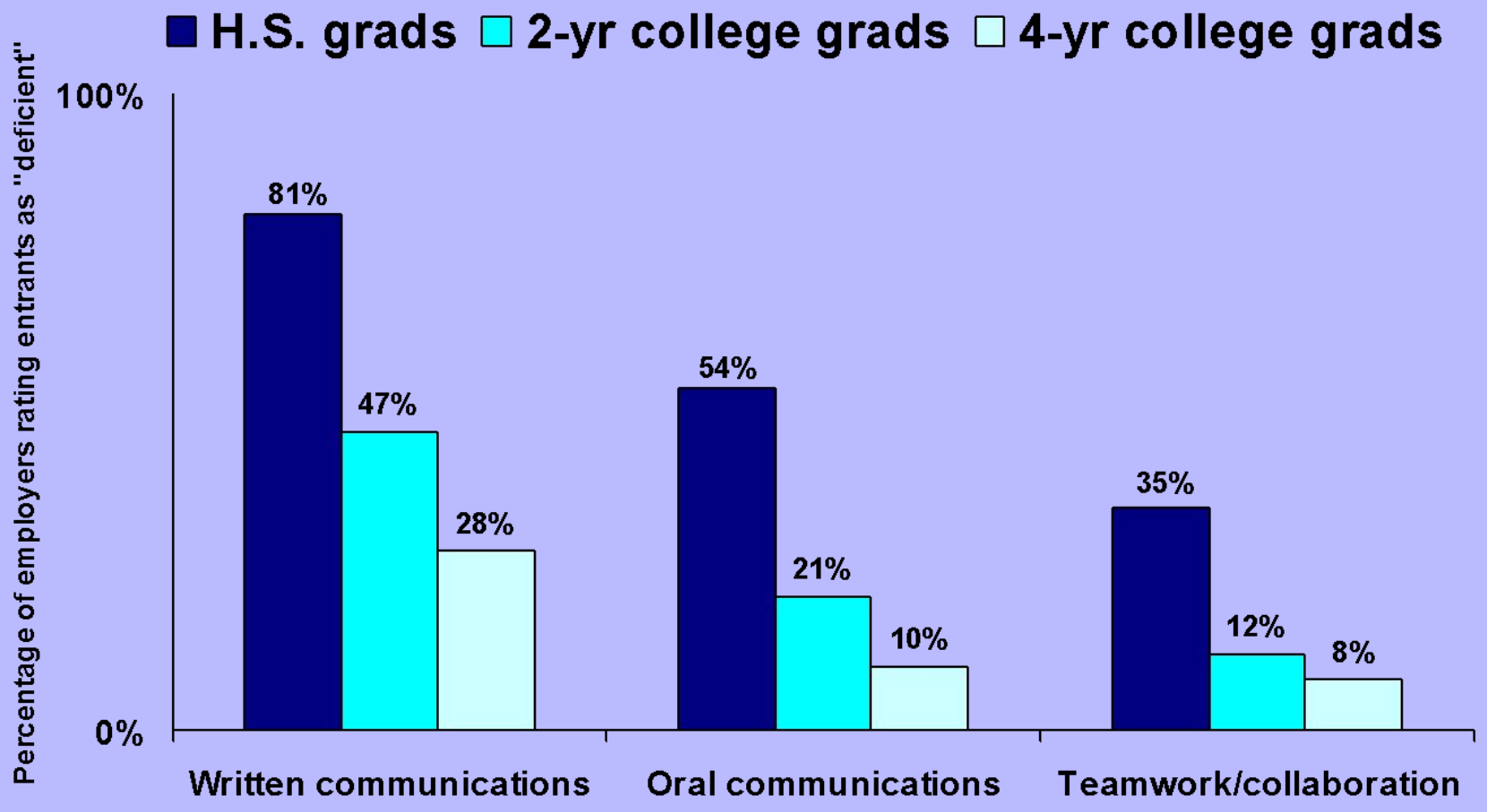
- **Both problems have essentially the same answer: *Dispersal of strength and re-gathering of strength at the point of attack*.**

- **Solving problems is hard because you get stuck on the surface facts and don't see the deeper patterns and relationships.**

Critical Thinking & Problem Solving: Require deep content knowledge

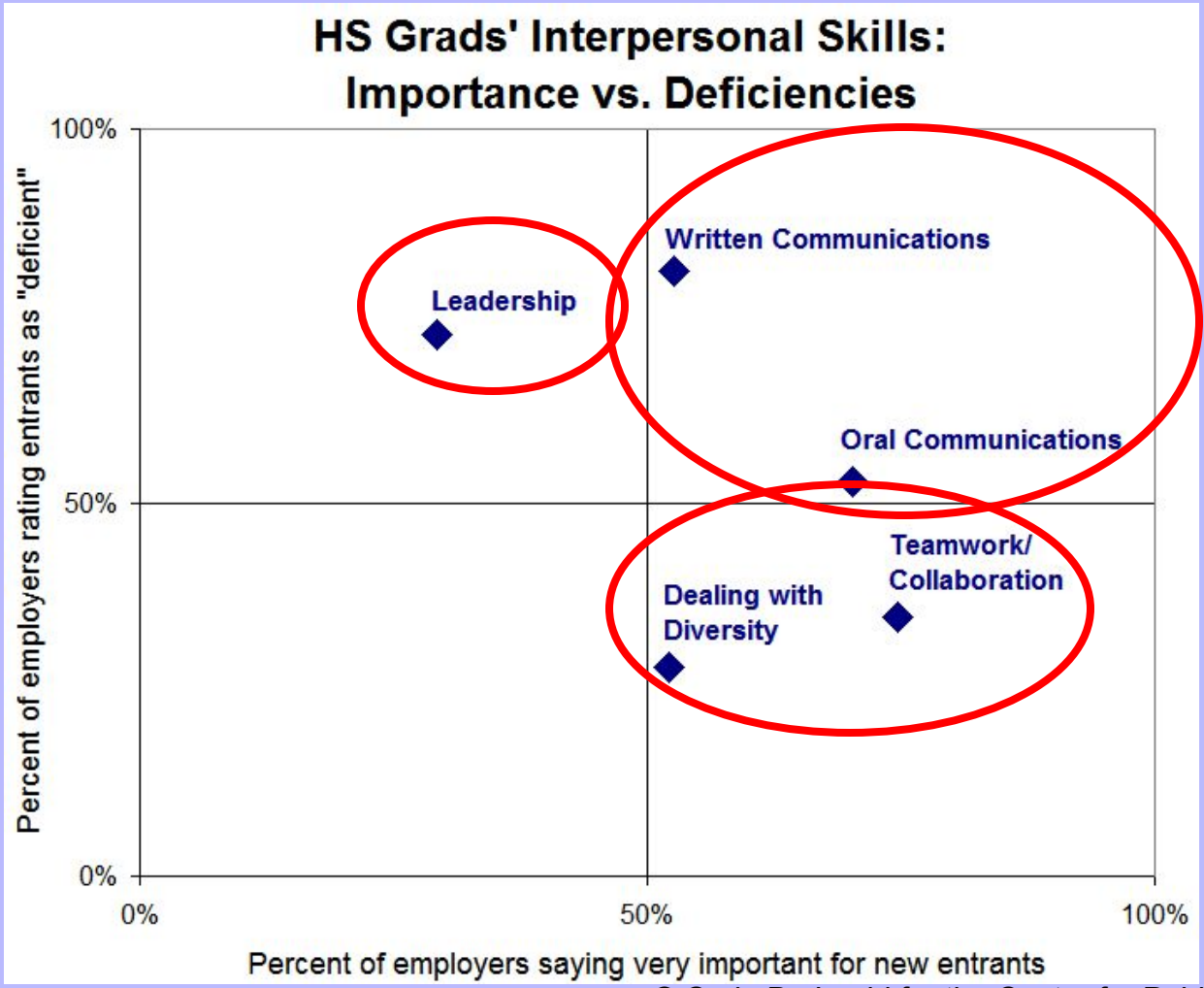
- Cognitive scientists used to believe that "thinking skills" could be taught directly and then applied to any situation.
- Now they believe that's wrong. Critical thinking is not a generic skill, but rather tied closely to contextual knowledge—deep understanding of the topic in question.
- What is "deep knowledge"? Getting below the surface:
  - WHATs: Factual knowledge about the field, and
  - WHYs & HOWs: How those facts fit together, how and why things are the way they are, and how things work the way they do.

Communication & Collaboration: Which interpersonal skills need most work?



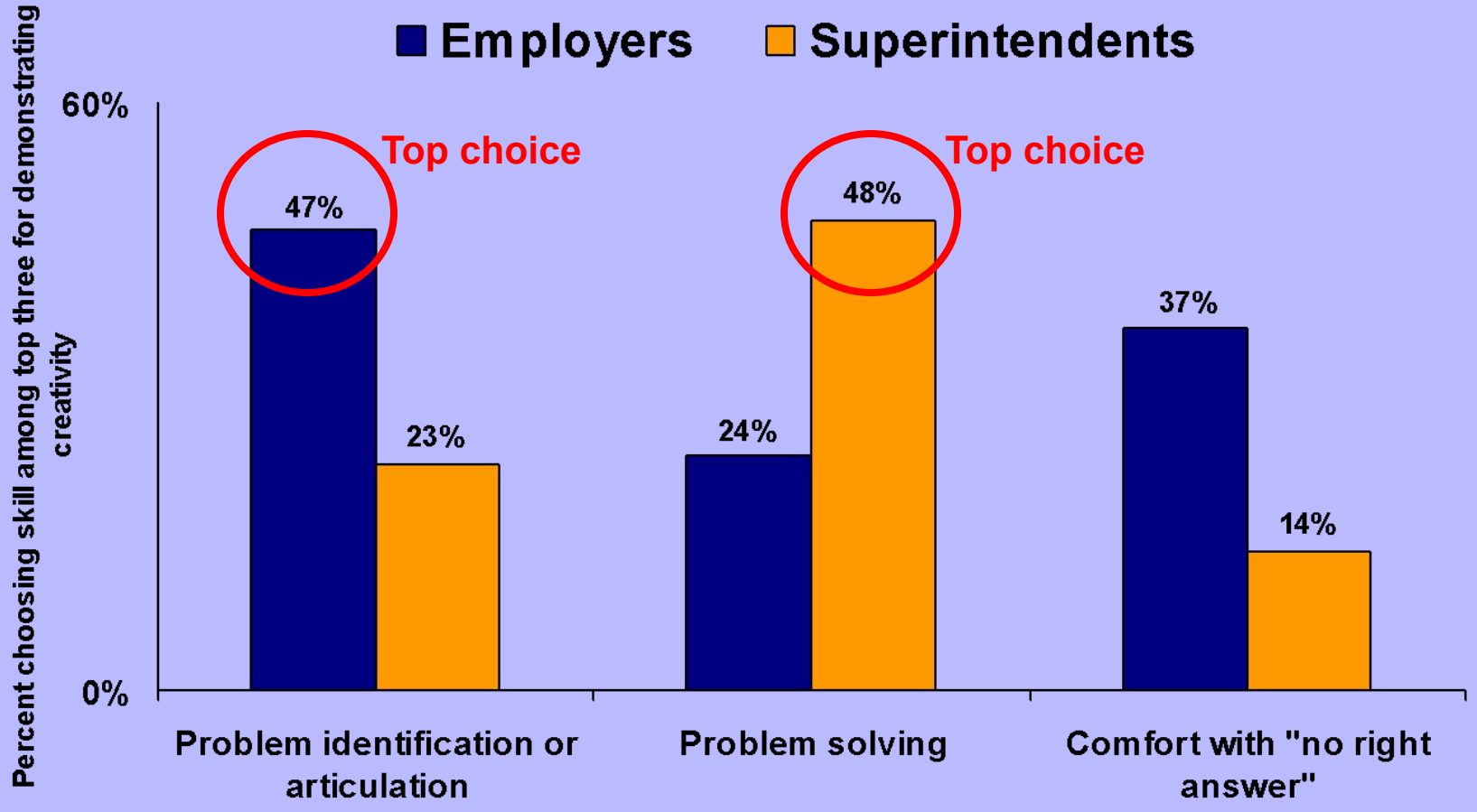
Source: Conference Board. (2006, October). *Are they really ready to work?* New York: Author. (pp. 32-34, Tables 6-8)

Communication & Collaboration: What are the most critical sub-skills?



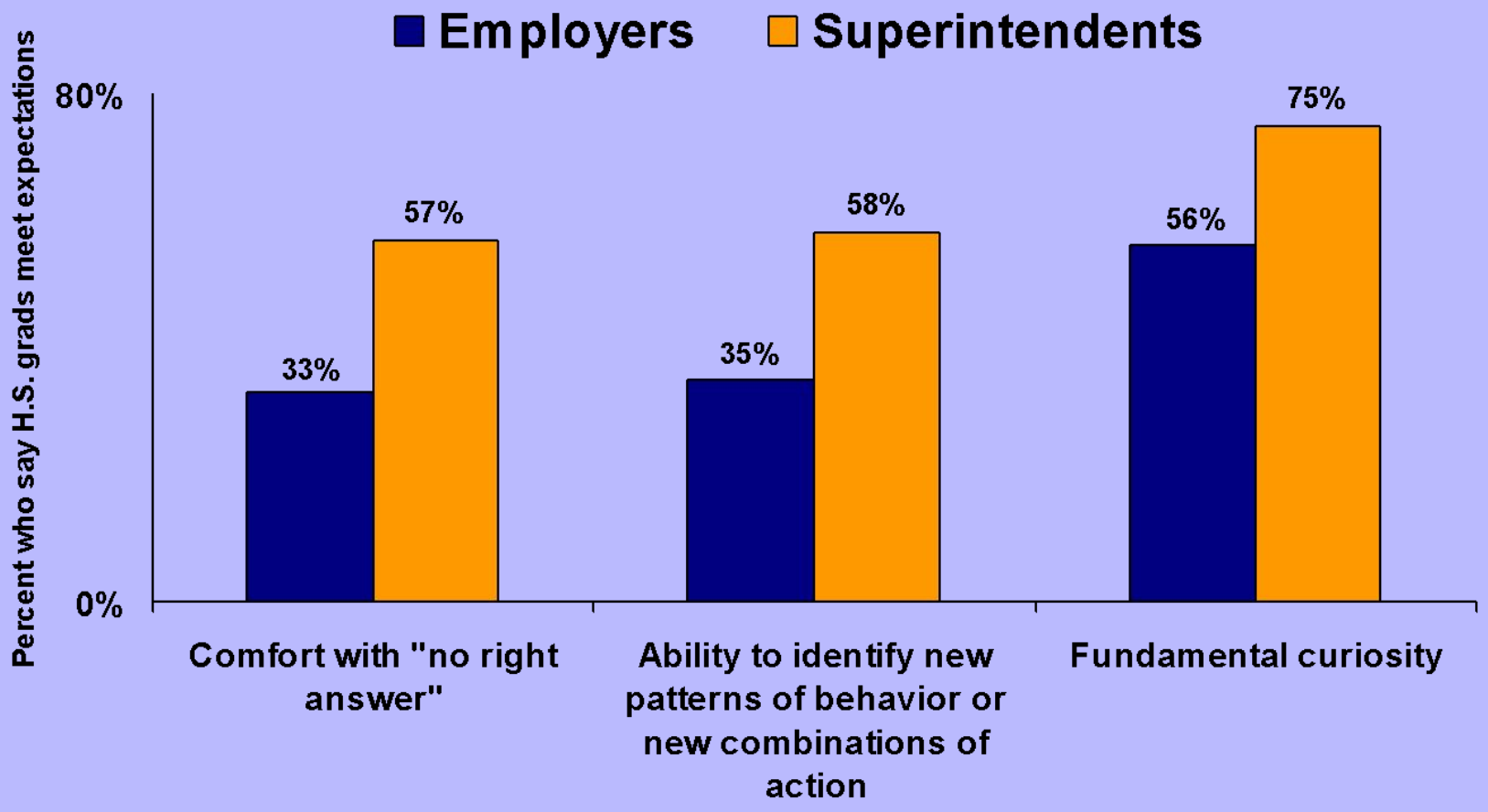
Source: Conference Board. (2006, October). *Are they really ready to work?* New York: Author. (pp. 32-34, Tables 6-8)

Creativity: Superintendents and employers define it differently



Source: Conference Board. (2008, March). *Ready to innovate: Are educators and executives aligned on the creative readiness of the U.S. workforce?* New York: Author. (p.7)

Creativity: Superintendents and employers have different views of H.S. grads' creativity skills



Source: Conference Board. (2008, March). *Ready to innovate: Are educators and executives aligned on the creative readiness of the U.S. workforce?* New York: Author. (p.7)

III. Implications for schools

Five big takeaways

- Students who obtain more education will be at a great advantage; increasingly, some postsecondary education or technical training is essential for an opportunity to support a family or secure a middle-class lifestyle.
- The need for traditional knowledge and skills in school subjects like math, language arts, and science is not being "displaced" by a new set of "thinking skills"; in fact, students who take more advanced math courses and master higher math skills, for example, will have a distinct advantage over their peers.
- At the same time, for success both on the job and in their personal lives, students must also better learn how to apply what they learn in those subjects to deal with real world challenges, rather than simply "reproduce" the information on tests.
- Students who develop an even broader set of in-demand competencies—the ability to think critically about information, solve novel problems, communicate and collaborate, create new products and processes, and adapt to change—will be at an even greater advantage in work and life.
- Applied skills and competencies can best be taught in the context of the academic curriculum, not as a replacement for it or "add on" to it; in fact, cognitive research suggests that some competencies like critical thinking and problem solving are highly dependent on deep content

And when it comes to competencies … clarity counts!

Don't assume "everyone knows" what [critical thinking/collaboration/creativity] is. Ask these questions:

1) **Is there a shared definition of [critical thinking/collaboration/creativity] in your district, or is everyone free to define it however they want?**

2) **Does the definition match the real world demand for that skill, e.g., the way employers define it?**

3) **Is the definition detailed and specific enough so that teachers and students and other stakeholders really understand what is expected of them?**

4) **Are these skills incorporated into the curriculum, or have you just asked teachers to "address them" somehow?**

A few policy implications

- Curriculum
  - Integrate into curriculum instead of purchasing stand-alone "thinking skills" programs: They don't work.
  - Where is the time for deeper understanding, real world application, problem solving?
  - Focus: U.S. tends to have a curriculum that is "a mile wide and an inch deep"—shallow and repetitive
    - EG, U.S. math textbooks cover almost twice as many topics per grade as Singapore's. In Singapore, students expected to complete about one thorough lesson on a single topic per week; in U.S., about one lesson on a narrowly focused topic *each day*
  - More time to explore subjects through open ended problems, collaborative projects, creativity

A Few Policy Implications

- Assessment
  - Teaching to the state test is too narrow:
    - EG, Recent study found that math tests in 10 states had too few complex problem solving questions to even measure whether there is a gender gap in such skills let alone whether students are being adequately prepared for real world work.
  - Supplement with more challenging local assessments (other countries do that).
  - Find early ways to gauge college preparedness, EG ACT's EPAS system.
  - For problem solving and applied literacy, key is to challenge students with less structured, more open ended problems in each subject. OECD's Programme

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