Science, Math, and 21st-Century Skills

Rethinking what a college education should be...

Keynote for the Charles A. Dana Center’s Annual Mathematics and Science Higher Education Conference
Presented by
Cathy Seeley, Dana Center senior fellow
October 8, 2009
Discussion

• What would it mean for a student to graduate from high school “college and career ready”?  

• How will they be different when they graduate from college? How might they become “life ready”? 
Various Reports / Recommendations

- *IN: Inside Innovation*—quarterly special insert from *Business Week*
- *Time* magazine, December 18, 2006
  [Cover: “How to build a student for the 21st Century”]
- *The World is Flat* (revised and expanded edition, 2007) and *Hot, Flat, and Crowded* (2008), by Thomas L. Friedman
  (more info at www.thomaslfriedman.com)
- *Business Week*, May 11, 2009
  [Cover: “The US has 3 million job openings: Why that may not be good news for the economy”]
“This is a story about the big public conversation the nation is not having about education, the one that will ultimately determine not merely whether some fraction of our children get ‘left behind’ but also whether an entire generation of kids will fail to make the grade in the global economy because they can't think their way through abstract problems, work in teams, distinguish good information from bad or speak a language other than English.”

—“How to Bring Our Schools Out of the 20th Century,” by Claudia Wallis. In *Time*, December 18, 2006 [emphasis added]
Tough Choices OR Tough Times

The report of the new Commission on the Skills of the American Workforce

—skillscommission.org/executive.htm
Profile of Successful Workers

- Top academic performance
- Able to learn very quickly
- Creative and innovative

—*Tough Choices or Tough Times*
National Center on Education and the Economy (2007)
Three Components of Creativity

What you know

Knowledge

Creative-thinking skills

Creativity

Motivation

How you approach problems

Intrinsic passion and interest work best

—Teresa M. Amabile, Harvard Business School
The Collective Message

- The flattening world is becoming a more level playing field.
- The US needs to take drastic steps to regain our competitive edge (or to participate in the global economy).
- It’s all about research and innovation.
- We need more well educated STEM workers.
- We need to rethink our educational goals and overhaul the educational system.
Preparing Students for...

- Work
- College
- Citizenship
The New Question

College and Career Readiness: What would it take for every student to graduate from high school ready for success in college or a well-paying career?
The core question is not about basic “access” to higher education.

... It is about completion of academic credentials—the culmination of opportunity, guidance, choice, effort, and commitment.

—The Toolbox Revisited: *Paths to Degree Completion From High School Through College.* US Department of Education (2006)
Students need ...

a comparable level of readiness in reading and mathematics....

if they are to succeed in college-level courses without remediation [or] to enter workforce training programs.

―“Ready for College and Ready for Work: Same or Different?” ACT (2006)
Algebra II … is a gateway course for higher education and teaches quantitative reasoning skills important for the workplace. Students that complete such coursework are not only better prepared for work, they earn higher salaries.

—Achieve, Inc.,
Texas Recommended High School Program

- *Four-by-four* graduation requirement for the class of 2011 and beyond:
  - Four years of Mathematics
  - Four years of Science
  - Four years of Social Studies/Economics
  - Four years of English Language Arts
Today’s World

Bill Gates:

• “By 2014, there will be more than two million job openings in the United States in STEM fields. Yet the number of American students graduating with degrees in these fields is declining.”

• “The goal should be to double the number of science, technology, and mathematics graduates by 2015.”
Two Goals

• More majors in math- and science-based fields (STEM—science, technology, engineering, mathematics)

• Every student quantitatively and scientifically literate to much more sophisticated levels than in the past, regardless of their field of interest
Where Do They Get What They Need?

- High school: 4 × 4
- Two-year colleges
- Four-year institutions
- Workforce training programs
Partnership for 21st-Century Skills
—www.21stcenturyskills.org
Partnership for 21st-Century Skills

- Core subjects
- 21st-century themes
  - Global awareness, civic literacy, health literacy, financial / economic understanding, business/entrepreneurial literacy

- Learning and innovation skills
  - Creativity, innovation, critical thinking, problem solving, communication and collaboration

- Information, media, and technology skills
  - Information literacy, media literacy, information and communication technology (ICT) literacy

- Life and career skills
  - Flexibility, adaptability, initiative, self-direction, social / cross-cultural skills, productivity, accountability, leadership and responsibility

www.21stcenturyskills.org, December 2008
21st-Century Skills?

Jay Mathews:

“How are millions of students still struggling to acquire 19th-century skills in reading, writing, and math supposed to learn this stuff?”

—Washington Post, January 5, 2009
21st-Century Skills?

“At its heart, say [E.D.] Hirsch and others, the conflict is about what should happen in a school day:

• Do kids learn to think by reading great literature, doing difficult math, and learning history, philosophy, and science?

• Or can they tackle those subjects on their own if schools simply teach them to problem-solve, communicate, use technology, and think creatively?”

—USA Today, March 5, 2009
Looking at 21st-Century Skills

- What real concerns/issues do Mathews, Hirsch et al., raise?
- What might be another point of view?
- How might you respond to them?
21st-Century Skills?

“At its heart, say [E .D.] Hirsch and others, the conflict is about what should happen in a school day:

• Do kids learn to think by reading great literature, doing difficult math, and learning history, philosophy, and science?

• Or can they tackle those subjects on their own if schools simply teach them to problem-solve, communicate, use technology, and think creatively?”

—USA Today, March 5, 2009
Some responses to E.D. Hirsch...

• We can’t have only two options.

• Maybe kids can learn to think not BY reading great literature or doing hard math, but WITH and THROUGH and WHILE doing challenging—yet engaging and relevant—literature, math, history, philosophy, or science.

• ... with the guidance of a good teacher.
College Learning for the New Global Century

Association of American Colleges & Universities

National Leadership Council for Liberal Education & America’s Promise (LEAP)

—www.aacu.org/resources/liberaleducation
What is a Liberal Education?

- Preparation to deal with complexity, diversity, change
- Broad knowledge of the wider world (science, culture, society)
- In-depth study of an area of interest
- Development of social responsibility
- Challenging encounters with important issues
- Strong, transferable intellectual / practical skills (communication, analytical / problem-solving skills, ability to apply knowledge in real world settings)

—www.aacu.org/leap/What_is_liberal_education.cfm
Essential Learning Outcomes

www.aacu.org/leap

• Human cultures and the physical and natural world
  – Sciences, mathematics, social sciences, humanities, histories, languages, arts

• Intellectual and practical skills
  – Inquiry/analysis, critical / creative thinking, written/oral communication, quantitative literacy, information literacy, teamwork, problem solving

• Personal and social responsibility
  – Civic knowledge and engagement (local / global), intercultural knowledge / competence, ethical reasoning & action, lifelong learning foundation / skills

• Integrative learning
  – Synthesis and advanced accomplishment across general and specialized studies

—AAC&U, LEAP, 2007 (www.aacu.org/leap)
Essential Learning Outcomes

- Human cultures and the physical and natural world
  - Focused by engagement with big questions (contemporary and enduring)

- Intellectual and practical skills
  - Practiced extensively across the curriculum, in the context of progressively more challenging problems, projects, and standards for performance

- Personal and social responsibility
  - Anchored through active involvement with diverse communities and real-world challenges

- Integrative learning
  - Demonstrated through the application of knowledge, skills, and responsibilities to new settings and complex problems

—AAC&U, LEAP, 2007 (www.aacu.org/leap)
Principles of Excellence

1. Aim high—and make excellence inclusive
2. Give students a compass
3. Teach the arts of inquiry and innovation
4. Engage the big questions
5. Connect knowledge with choices and action
6. Foster civic, intercultural, and ethical learning
7. Assess students’ ability to apply learning to complex problems

—AAC&U, LEAP, 2007 (www.aacu.org/leap)
How to Get There...

• Make the *Principles of Excellence* a priority on campus
• Form coalitions—across sectors—for all students’ long-term interests
• Build principled and determined leadership (administrative, curricular, policy, community)
• Put employers in direct dialogue with students
• Reclaim the connections between liberal education and democratic freedom

How to Get There...

• Make the *Principles of Excellence* a priority on campus
• Form coalitions—across sectors—for all students’ long-term interests
• Build principled and determined leadership (administrative, curricular, policy, community)
• Put employers in direct dialogue with students
• Reclaim the connections between liberal education and democratic freedom

Discussion

• How well do these principles fit with your vision of teaching the sciences and/or mathematics?

• Which of these principles do you think your department/institution currently best addresses?

• Are there principles in this list that you might target for action in the near future?
More than Content

- Engage students in their learning:
  - Choose engaging, challenging, stimulating tasks
  - Ask questions that push thinking (not fill-in-the-blanks)
  - Talk less; listen more
“The best professors in the world don’t like hearing themselves speak.”

—An ad in *Business Week* for the University of Virginia’s Darden School of Business
More than Content

- How to use technological tools in appropriate ways to support teaching and learning
- Different problems and different ways of approaching problems
- Different models of what teaching is
- Different responsibilities for, expectations of, and commitments from students regarding what learning is
Fundamental Issues

• Two key considerations:
  - How we teach mathematics and the sciences in higher education matters for what students can do when they graduate in the 21st century.
  - How we teach mathematics and the sciences in higher education influences what happens in high school math and science to prepare students for college and the workplace.
Fundamental Issues

• Should we push down what we think we want?

• Are our expectations for what high school students should bring to college realistic in this very different global century?

• Can we build on what is possible in high school?

• Can we actively participate together in real revitalization of prekindergarten–16+ education?
The Bottom Line

• Can we step up and ramp up what we teach and expand the group we teach to?
• We can’t afford not to.
• Their future is in our hands.
Their future is in our hands

...and ours is in theirs
Contact Info & Resources

Email (for a link to a pdf of the slides): Cathy Seeley, cseeley@mail.utexas.edu

My new book (May 2009)
Faster Isn’t Smarter—Messages About Math, Teaching, and Learning in the 21st Century
(a resource for teachers, families, leaders, and policy makers)

Charles A. Dana Center at The University of Texas at Austin: www.utdanacenter.org

National Council of Teachers of Mathematics: nctm.org

Check out my websites: cathyseeley.com and csinburkinafaso.com