Preparing Students for an Interdependent World:
Role of Cooperation and Social Interdependence Theory

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Engineering Education:
Towards Building World Class Human Capital

Regional Conference on Engineering Education – Johor 2007

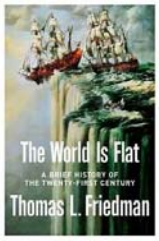
December 3-5, 2007

John F. Kennedy Moon Speech - Rice Stadium

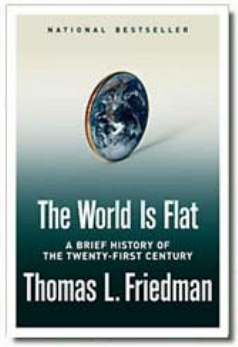
September 12, 1962

Apollo 8 – 12/29/68

The World is Flat



"Clearly, it is now possible for more people than ever to collaborate and compete in real-time, with more people, on more kinds of work, from more corners of the planet, and on a more equal footing, than at any previous time in the history of the world"



Platform for Collaboration
(1st Three Flatteners):
1. 11/9/89
2. 8/9/95
3. Work Flow Software

NYTimes MAGAZINE April 3, 2005
It's a Flat World, After All
By THOMAS L. FRIEDMAN

Video – Think Global Series:
http://minnesota.publicradio.org/radio/features/2005/05/collaboration/

Age of Interdependence

Tom Boyle of British Telecom calls this the age of interdependence; he speaks of the importance of people's NQ, or network quotient – their capacity to form connections with one another, which, Boyle argues is now more important than IQ, the measure of individual intelligence.

Cohen, Don & Prusak, Laurence. 2001. *In good company: How social capital makes organizations work*. Cambridge, MA: Harvard Business School Press.

Sunday
JANUARY 13, 2002

Opinion

A17
Editorials, A18

A selection of voices from the community, nation and world

Living in an interdependent world

Former President Bill Clinton addresses the question: Is the age of interdependence going to be good or bad for humanity? He thinks it will turn out to be good — but he cautions that the West must help those who are being left behind.

The great question of this new century is whether the age of interdependence is going to be good or bad for humanity. The answer depends upon whether we in the wealthy nations spread the benefits and reduce the burdens of the modern world, on whether the poor nations enact the changes necessary to make progress possible, and on whether we all can develop a level of consciousness high enough to understand our obligations and responsibilities to each other.

By William Jefferson Clinton

NEW YORK — The great question of this new century is whether the age of interdependence is going to be good or bad for humanity. The answer

Fourth, from a political point of view, you might have said the dominant factor of the 21st-century world will be the explosion of democracy and diversity.

For the first time in the history of

Interdependent World

- Essential knowledge, skills, habits of mind, … for an interdependent world?
  - Reflect individually and list essential skills ~ 1'
  - Turn to the person next to you ~ 2'
    - Introduce yourself
    - Compare lists
    - Develop a joint list
  - Present to whole group (if randomly selected)

The reports…

- *Engineering Research and America's Future* (NAE, 2005): Committee to Assess the Capacity of the U.S. Engineering Research Enterprise
- *The Engineer of 2020* (NAE, 2004) and *Educating the Engineer of 2020* (NAE, 2005)
- *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future* (NRC/COSEPUP, 2005)
- *Innovate American: National Innovation Initiative Final Report* (Council on Competitiveness, 2005)

Successful Attributes for the Engineer of 2020

- Possess strong analytical skills
- Exhibit practical ingenuity; posses creativity
- Good communication skills with multiple stakeholders
- Business and management skills; Leadership abilities
- High ethical standards and a strong sense of professionalism
- Dynamic/agile/resilient/flexible
- Lifelong learners

Desired Attributes of a Global Engineer*

- A good grasp of these engineering science fundamentals, including:
  - Mechanics and dynamics
  - Mathematics (including statistics)
  - Physical and life sciences
  - Information science/technology
- A good understanding of the design and manufacturing process (i.e., understands engineering and industrial perspective)
- **A multidisciplinary, systems perspective, along with a product focus**
- A basic understanding of the context in which engineering is practiced, including:
  - Customer and societal needs and concerns
  - Economics and finance
  - The environment and its protection
  - The history of technology and society
- **An awareness of the boundaries of one's knowledge, along with an appreciation for other areas of knowledge and their interrelatedness with one's own expertise**
- **An awareness of and strong appreciation for other cultures and their diversity, their distinctiveness, and their inherent value**
- **A strong commitment to team work, including extensive experience with and understanding of team dynamics**
- Good communication skills, including written, verbal, graphic, and listening
- **High ethical standards (honesty, sense of personal and social responsibility, fairness, etc)**
- **An ability to think both critically and creatively, in both independent and cooperative modes**
- Flexibility: the ability and willingness to adapt to rapid and/or major change
- Curiosity and the accompanying drive to learn continuously throughout one's career
- An ability to impart knowledge to others

*A Manifesto for Global Engineering Education, Summary Report of the Engineering Futures Conference, January 22-23, 1997. The Boeing Company & Rensselaer Polytechnic Institute.

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Purdue's Future Engineer

Vision: Purdue Engineers will be prepared for leadership roles in responding to the global technological, economic, and societal challenges of the 21st century.

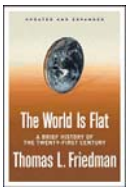
Strategy: We will provide educational experiences that develop students' knowledge areas, abilities, and qualities to enable them to identify needs and construct effective solutions in an economically, socially, and culturally relevant manner.

Abilities	Knowledge Areas	Qualities
• leadership • teamwork • communication • decision-making • recognize & manage change • work effectively in diverse & multicultural environments • work effectively in the global engineering profession • synthesize engineering, business, and societal perspectives	• science & math • engineering fundamentals • analytical skills • open-ended design & problem solving skills • multidisciplinarity within and beyond engineering • integration of analytical, problem solving, and design skills	• innovative • strong work ethic • ethically responsible in a global, social, intellectual, and technological context • adaptable in a changing environment • entrepreneurial and intrapreneurial • curious and persistent continuous learners

The Three Pillars of the Purdue Engineering Undergraduate Education

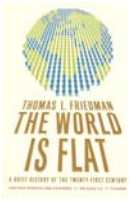
Design Thinking

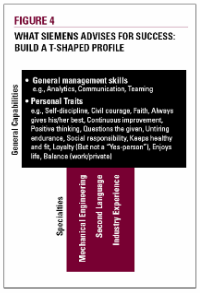
Discipline Thinking



Tom Friedman
Horizontalize
Ourselves

CQ+PQ>IQ





AAC&U *College Learning For the New Global Century*

Lynn & Salzman – Collaborative Advantage & The Real Global Technology Challenge

The Future of Engineering Education
Context and Musings

Charles M. Vest
President, NAE

ABET Annual Meeting
Incline Village, NV
November 2, 2007

Context and Goals for Technological Education

- A New Century
- New Innovation and Enterprise Models
- New Technological Frontiers
- Engineering Leadership

Some Personal Views and Questions

- What is important in Engineering Education?
- The Need for Research and Assessment of Teaching and Learning
- Can we define The Body of Knowledge?
- Innovation in Teaching and Learning

What is important in Engineering Education

Making universities and engineering schools exciting, creative, adventurous, rigorous, demanding, and empowering milieus is more important than specifying curricular details.

Preparing Students for an Interdependent World: Role of Cooperation and Social Interdependence Theory

How to we help students develop the knowledge, skills and habits of mind needed for effective participation?

Opportunities for the

Participants in the RCEE 2007

In my entire life as a student, I remember only twice being given the opportunity to come up with my own ideas, a fact I consider typical and terrible. I would like to start this paper by telling how I came to realize that schooling could be different from what I had experienced.

Eleanor Duckworth, Twenty-four, forty-two, and I love you: Keeping it complex, *Harvard Educational Review*, *61* (1991), 1-24.

Pedago-pathologies

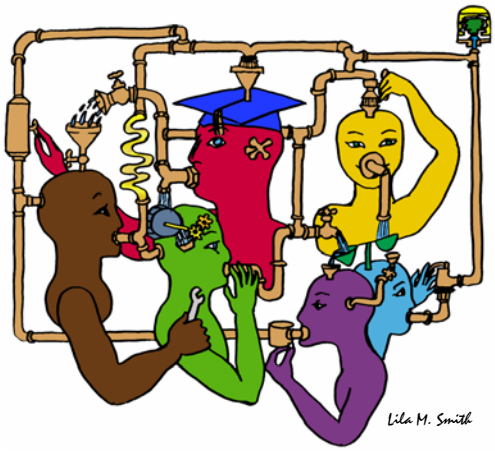
Amnesia

Fantasia

Inertia

Lee Shulman – MSU Med School – PBL Approach (late 60s – early 70s), Currently President of the Carnegie Foundation for the Advancement of College Teaching

Shulman, Lee S. 1999. Taking learning seriously. *Change, 31* (4), 11-17.



Pedagogies of Engagement

Foundations for Pedagogies of Engagement

1. Learning is a social activity (John Dewey)
2. Innovative learning requires ambiguity (Stuart Pugh)
3. All learning requires un-learning (John Seely Brown)
4. Learning is situated (Jean Lave)

Foundations - John Dewey

John Dewey's ideal school:

- •a "thinking" curriculum aimed at deep understanding
- •**cooperative learning within communities of learners**
- •interdisciplinary and multidisciplinary curricula
- •projects, portfolios, and other "alternative assessments" that challenged students to integrate ideas and demonstrate their capabilities.

Dewey, John. 1915. The school and society, 2nd ed. Chicago: University of Chicago Press.

Cooperative Learning

- Theory – Social Interdependence – Lewin – Deutsch – Johnson & Johnson
- Research – Randomized Design Field Experiments
- Practice – Formal Teams/Professor's Role

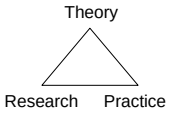
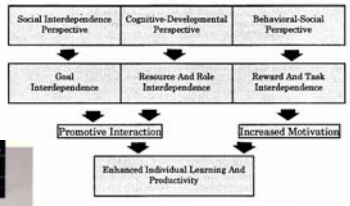


Figure A.1 A General Theoretical Framework



Cooperative Learning
- •Positive Interdependence
- •Individual and Group Accountability
- •Face-to-Face Promotive Interaction
- •Teamwork Skills
- •Group Processing

Cooperative Learning Research Support

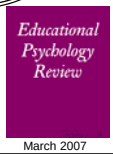
Johnson, D.W., Johnson, R.T., & Smith, K.A. 1998. Cooperative learning returns to college: What evidence is there that it works? *Change*, *30* (4), 26-35.

- Over 300 Experimental Studies
- First study conducted in 1924
- High Generalizability
- Multiple Outcomes

Outcomes

1. Achievement and retention
2. Critical thinking and higher-level reasoning
3. Differentiated views of others
4. Accurate understanding of others' perspectives
5. Liking for classmates and teacher
6. Liking for subject areas
7. Teamwork skills

January 2005

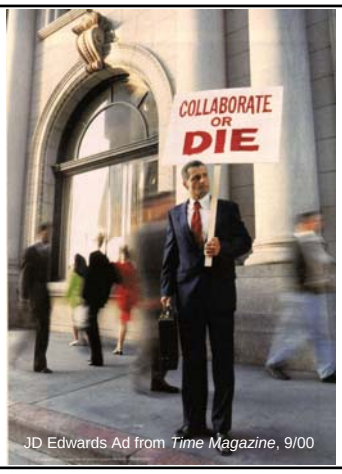


March 2007

Shaping the Future: New Expectations for Undergraduate Education in Science, Mathematics, Engineering and Technology – **National Science Foundation, 1996**

Goal – All students have access to supportive, excellent undergraduate education in science, mathematics, engineering, and technology, and all students learn these subjects by direct experience with the methods and processes of inquiry.

Recommend that SME&T faculty: Believe and affirm that every student can learn, and model good practices that increase learning; starting with the student's experience, but have high expectations within a supportive climate; and build inquiry, a sense of wonder and the excitement of discovery, plus communication and teamwork, critical thinking, and life-long learning skills into learning experiences.



JD Edwards Ad from *Time Magazine*, 9/00

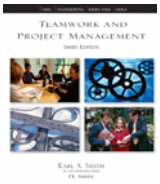
Top Three Main Engineering Work Activities

Engineering Total

- Design – 36%
- Computer applications – 31%
- Management – 29%

Civil/Architectural

- Management – 45%
- Design – 39%
- Computer applications – 20%



Burton, L., Parker, L, & LeBold, W. 1998. U.S. engineering career trends. *ASEE Prism*, 7(9), 18-21.

Preparing Students for an Interdependent World

"If we cannot end now our differences, at least we can help make the world safe for diversity."

President John F. Kennedy, Commencement Address, American University, June 10, 1963.

Cited in Harlan Cleveland, *Nobody in charge: Essays on the future of leadership*, Jossey-Bass, 2002.

Safe for Diversity

The required solvent for civilization is respect for differences. The art is to *be different together.*

Civilization will be built by cooperation and compassion, in a social climate in which people of different groups can deal with each other in ways that respect their cultural differences.

Harlan Cleveland, *Nobody in charge: Essays on the future of leadership*, Jossey-Bass, 2002.