Designing Innovative
Higher Education Programs:
Insights from Research and Practice

Karl A. Smith
Engineering Education – Purdue University
Civil Engineering - University of Minnesota
ksmith@umn.edu
http://www.ce.umn.edu/~smith

Learning Impact Through Teaching Innovation

HKUST – Teaching and Learning Symposium

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It could well be that faculty members of the twenty-first century college or university will find it necessary to set aside their roles as teachers and instead become designers of learning experiences, processes, and environments. - James Duderstadt, 1999 [Nuclear Engineering Professor; Dean, Provost and President of the University of Michigan]

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Guiding Questions

- What are we preparing students for?
- How will we know if we succeeded?
- What do we do to prepare them?
- Are there models and resources available to assist?

Resources

http://books.nap.edu/openbook.php?record_id=10239&page=159

http://www.skillscommission.org/commissioned.htm

- Bransford, Vye and Bateman – Creating High Quality Learning Environments
- Pellegrino – Rethinking and Redesigning Curriculum, Instruction and Assessment

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Backward Design
Wiggins & McTighe

Stage 1. Identify Desired Results

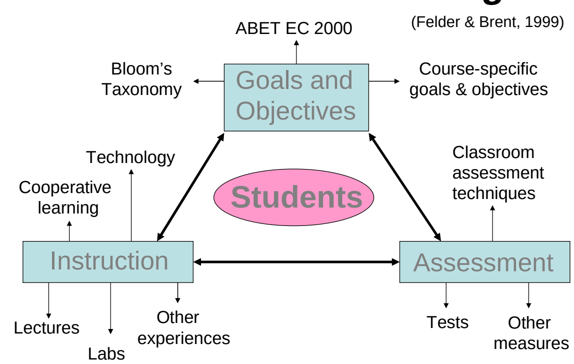
Stage 2. Determine Acceptable Evidence

Stage 3. Plan Learning Experiences and Instruction

Wiggins, Grant and McTighe, Jay. 1998. *Understanding by Design*. Alexandria, VA: ASCD

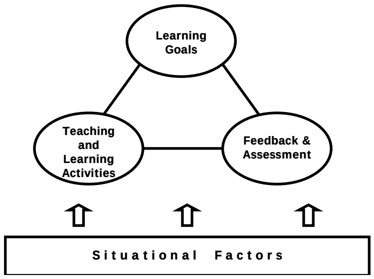
Effective Course Design

(Felder & Brent, 1999)



Model 1

The Key Components Of INTEGRATED COURSE DESIGN



A Self-Directed Guide to Designing Courses for Significant Learning
L. Dee Fink. 2003. *Creating significant learning experiences*. Jossey-Bass.

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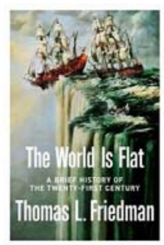
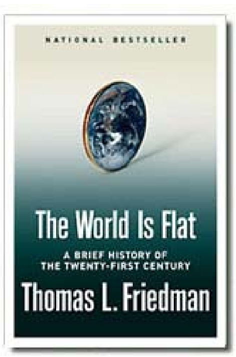
Preparing Students for an Interdependent World:
Role of Cooperation and Social Interdependence Theory

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.

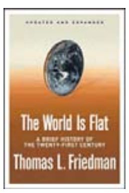
The great question of this new century is whether the age of interdependence is going to be good or bad for humanity. The answer depends upon whether we in the wealthy nations spread the benefits and reduce the burdens of the modern world, on whether the poor nations enact the changes necessary to make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

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)

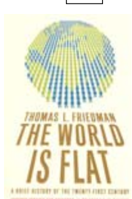
Design Thinking

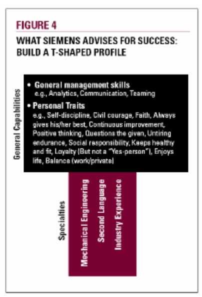
Discipline Thinking



Tom Friedman
Horizontalize
Ourselves

CQ+PQ>IQ





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

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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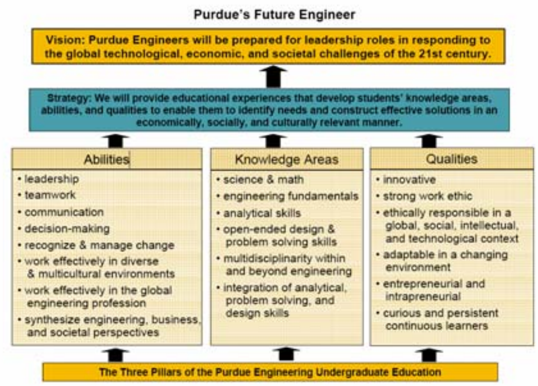

Backward Design

Stage 1. Identify Desired Results

Filter 1. To what extent does the idea, topic, or process represent a big idea or having enduring value beyond the classroom?

Filter 2. To what extent does the idea, topic, or process reside at the heart of the discipline?

Filter 3. To what extent does the idea, topic, or process require uncoverage?

Filter 4. To what extent does the idea, topic, or process offer potential for engaging students?

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Backward Design

Stage 2. Determine Acceptable Evidence

Types of Assessment

Quiz and Test Items:
Simple, content-focused test items

Academic Prompts:
Open-ended questions or problems that require the student to think critically

Performance Tasks or Projects:
Complex challenges that mirror the issues or problems faced by graduates, they are authentic

Taxonomies

Bloom's taxonomy of educational objectives: Cognitive Domain (Bloom & Krathwohl, 1956)

A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives (Anderson & Krathwohl, 2001).

Facets of understanding (Wiggins & McTighe, 1998)

Taxonomy of significant learning (Dee Fink, 2003)

A taxonomic trek: From student learning to faculty scholarship (Lee Shulman, 2002)

The Cognitive Process Dimension →

The Knowledge Dimension ↓

	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual Knowledge – The basic elements that students must know to be acquainted with a discipline or solve problems in it. a. Knowledge of terminology b. Knowledge of specific details and elements	Recall	Restate	Employ	Distinguish	Select	Arrange
Conceptual Knowledge – The interrelationships among the basic elements within a larger structure that enable them to function together. a. Knowledge of classifications and categories b. Knowledge of principles and generalizations c. Knowledge of theories, models, and structures	Define	Describe	Translate	Compare	Defend	Combine
Procedural Knowledge – How to do something; methods of inquiry, and criteria for using skills, algorithms, techniques, and methods. a. Knowledge of subject-specific skills and algorithms b. Knowledge of subject-specific techniques and methods c. Knowledge of criteria for determining when to use appropriate procedures	Relate	Identify	Demonstrate	Contrast	Interpret	Construct
Metacognitive Knowledge – Knowledge of cognition in general as well as awareness and knowledge of one's own cognition. a. Strategic knowledge b. Knowledge about cognitive tasks, including appropriate contextual and conditional knowledge c. Self-knowledge	Review	Express	Examine	Deduce	Discriminate	Propose

Imbrie and Brophy, 2007

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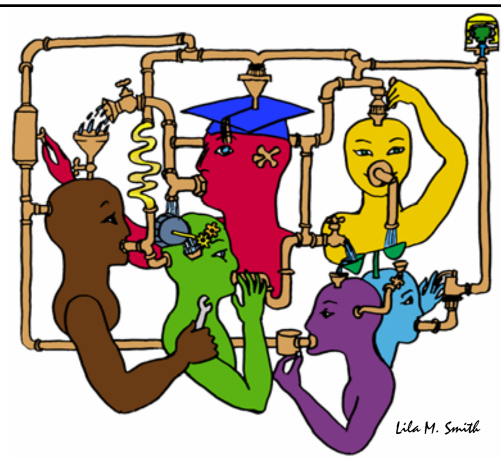
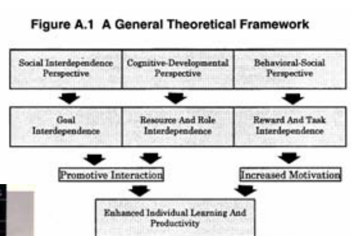
Lila M. Smith



Pedagogies of Engagement

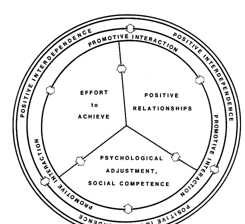


Cooperative Learning
- Positive Interdependence
- Individual and Group Accountability
- Face-to-Face Promotive Interaction
- Teamwork Skills
- Group Processing

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.

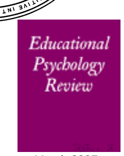
- Over 300 Experimental Studies
- First study conducted in 1924
- High Generalizability
- Multiple Outcomes



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



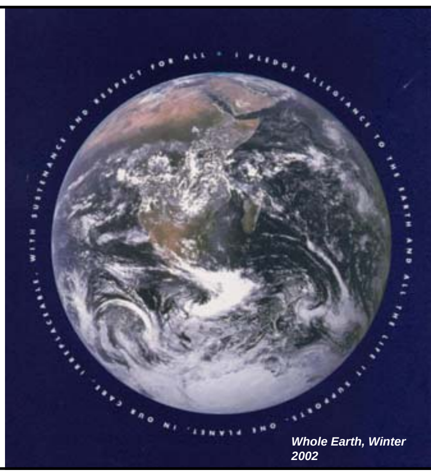
March 2007

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.

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



Whole Earth, Winter 2002