Foundations of Design of High Performance Team Learning Environments – *Understanding by Design* and *How People Learn*

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

Nanyang Business School
Nanyang Technological University

Teaching Strategies for Cooperative Learning Workshop

December 12-15, 2011

Session 1 Layout

- Welcome & Overview
- Course Design Foundations
  - Understanding by Design (UdB)
    - Integrated Course Design (CAP Model)
      - Content – Assessment – Pedagogy
  - How People Learn (HPL)
    - How Learning Works (Ambrose, et al.)
- Session 2 Preview – Pedagogies of Engagement – Cooperative Learning and Challenge Based Learning
  - Informal – Bookends on a Class Session
  - Formal Cooperative Learning
- Design and Implementation

Session objectives

1. Articulate an integrated approach to course design which aligns content, assessment and pedagogy (CAP)
2. Critically describe the research-based features of CAP
3. Apply CAP principles to a learning environment (course, module, etc).
4. Use reflection and discussion to deepen your learning.

What do you already know about course design?

[Background Knowledge Survey]

- What is your experience with course (re) design?
  - 1-5: never done it (1) to very experienced (5)
- What is your level of familiarity with HPL & UbD?
  - 1-5: low (1) to high (5)

What do you already know about course design?

[Background Knowledge Survey]

Short Answer Questions

- What do you feel are important considerations about course (re) design?
- What are challenges you have faced with course (re) design?

*"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

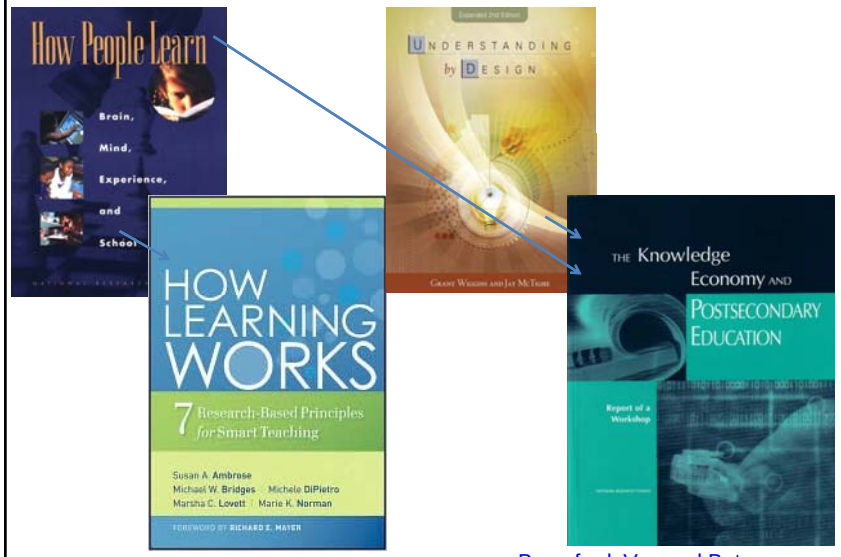
Design Foundations

Science of Instruction (UbD)

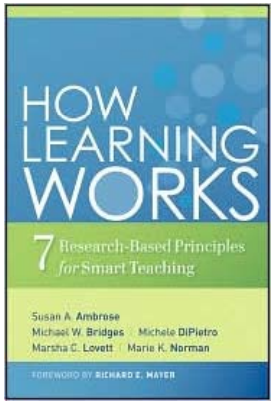
Science of Learning (HPL)

	No	Yes
Yes	Good Theory/ Poor Practice	Good Theory & Good Practice
No		Good Practice/ Poor Theory

Sources: Bransford, Brown & Cocking. 1999. *How people learn.* National Academy Press.
Wiggins, G. & McTighe, J. 2005. *Understanding by design, 2ed*. ASCD.



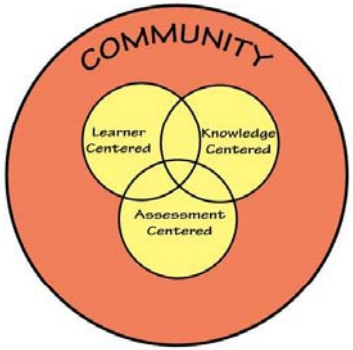
•Bransford, Vye and Bateman – Creating High Quality Learning Environments



1. Students prior knowledge can help or hinder learning
2. How student organize knowledge influences how they learn and apply what they know
3. Students' motivation determines, directs, and sustains what they do to learn
4. To develop mastery, students must acquire component skills, practice integrating them, and know when to apply what they have learned
5. Goal-directed practice coupled with targeted feedback enhances the quality of students' learning
6. Students' current level of development interacts with the social, emotional, and intellectual climate of the course to impact learning
7. To become self-directed learners, students must learn to monitor and adjust their approach to learning

How People Learn (HPL)

HPL Framework



- Expertise Implies (Ch. 2):
  - a set of cognitive and metacognitive skills
  - an organized body of knowledge that is deep and contextualized
  - an ability to notice patterns of information in a new situation
  - flexibility in retrieving and applying that knowledge to a new problem

Bransford, Brown & Cocking. 1999. *How people learn.* National Academy Press.

10

Understanding by Design

Wiggins & McTighe (1997, 2005)

Stage 1. Identify Desired Results

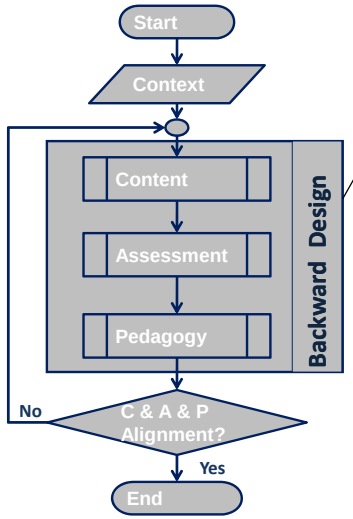
Stage 2. Determine Acceptable Evidence

Stage 3. Plan Learning Experiences and Instruction

Overall: *Are the desired results, assessments, and learning activities ALIGNED?*

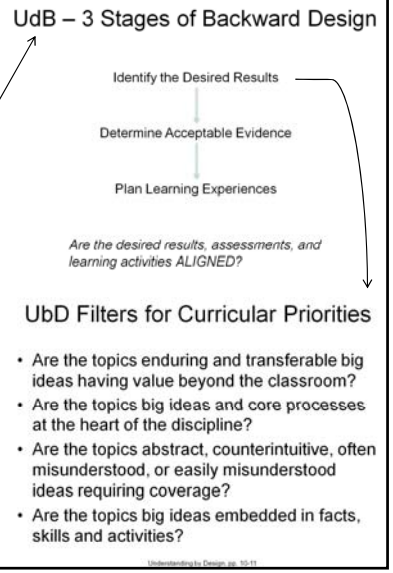
From: Wiggins, Grant and McTighe, Jay. 1997. *Understanding by Design*. Alexandria, VA: ASCD

Content-Assessment-Pedagogy (CAP) Design Process Flowchart

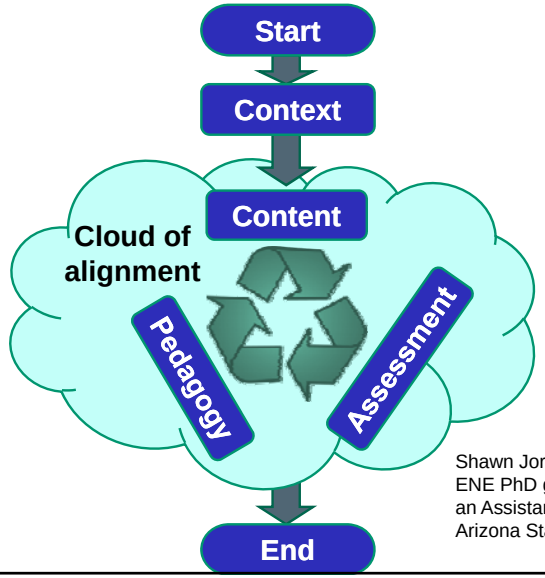


Streveler, Smith & Pilotte (2011)

Understanding by Design (Wiggins & McTighe, 2005)



CAP Design Process (Shawn Jordan's Model)



Shawn Jordan is a 2010 ENE PhD graduate who is an Assistant Professor at Arizona State University

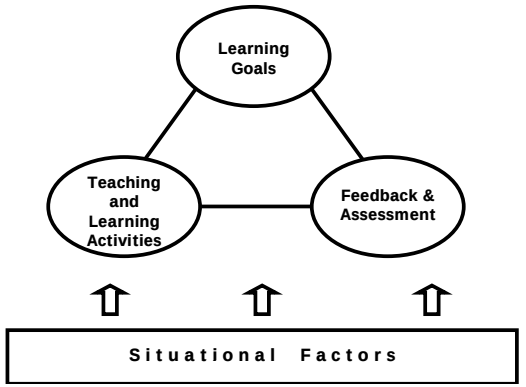
Related Integrated Course Design Model

- Fink, L.D. 2003. *Creating significant learning experiences: An integrated approach to designing*. Jossey-Bass
- Fink, L.D. 2003. A Self-Directed Guide to Designing Courses for Significant Learning. http://www.deefinkandassociates.com/GuidetoCourseDesignAug05.pdf

14

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.

15

Your turn

Select a course or learning module you would like to (re)design especially by incorporating cooperative learning

16

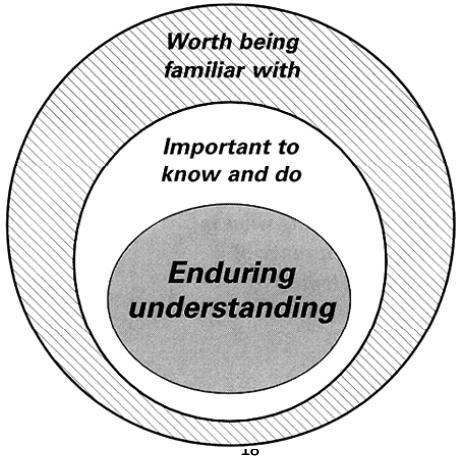
3 Stages of Understanding by Design

Identify the Desired Results

What should students know, understand, and be able to do?

Three categories of learning outcomes:
(1) **Enduring understandings**
(2) Important to know
(3) Good to be familiar with

Establishing Curricular Priorities



Your turn

- What are your intentions for student learning?
  - Individually make a list

Filters

UbD Filters for Curricular Priorities

- Are the topics enduring and transferable big ideas having value beyond the classroom?
- Are the topics big ideas and core processes at the heart of the discipline?
- Are the topics abstract, counterintuitive, often misunderstood, or easily misunderstood ideas requiring coverage?
- Are the topics big ideas embedded in facts, skills and activities?

Understanding by Design, pp. 10-11

Understanding Misunderstanding

A Private Universe – 21 minute video available from www.learner.org

Also see *Minds of our own* (Annenberg/CPB Math and Science Collection – www.learner.org)

1. Can we believe our eyes?
2. Lessons from thin air
3. Under construction

21

Your turn

- Which of these learning outcomes represents the enduring understandings?

Your turn

- Share your list with a partner
- Discuss each other's list for enduring understanding.
  - Questions?
  - Clarifications?

3 Stages of Understanding by Design

Identify the Desired Results

Determine Acceptable Evidence

How will we know if the students have achieved the desired results? What will be accepted as evidence of student understanding and proficiency?

Understanding Understanding

Stage 1. Identify Desired Results
Focus Question: What does it mean to "understand"?

Stage 2. Determine Acceptable Evidence
Focus Questions: "How will we know if students have achieved the desired results and met the standards? What will we accept as evidence of student understanding and proficiency (Wiggins & McTighe)

25

Taxonomies of Types of Learning

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 (Fink, 2003)

Evaluating the quality of learning: The SOLO taxonomy (Biggs & Collis, 1982)

26

The Six Major Levels of Bloom's Taxonomy of the Cognitive Domain (with representative behaviors and sample objectives)

Knowledge. Remembering information *Define, identify, label, state, list, match*
- Identify the standard peripheral components of a computer
- Write the equation for the Ideal Gas Law

Comprehension. Explaining the meaning of information *Describe, generalize, paraphrase, summarize, estimate*
- In one sentence explain the main idea of a written passage
- Describe in prose what is shown in graph form

Application. Using abstractions in concrete situations *Determine, chart, implement, prepare, solve, use, develop*
- Using principles of operant conditioning, train a rate to press a bar
- Derive a kinetic model from experimental data

Analysis. Breaking down a whole into component parts *Points out, differentiate, distinguish, discriminate, compare*
- Identify supporting evidence to support the interpretation of a literary passage
- Analyze an oscillator circuit and determine the frequency of oscillation

Synthesis. Putting parts together to form a new and integrated whole *Create, design, plan, organize, generate, write*
- Write a logically organized essay in favor of euthanasia
- Develop an individualized nutrition program for a diabetic patient

Evaluation. Making judgments about the merits of ideas, materials, or phenomena *Appraise, critique, judge, weigh, evaluate, select*
- Assess the appropriateness of an author's conclusions based on the evidence given
- Select the best proposal for a proposed water treatment plant

27

The Cognitive Process Dimension

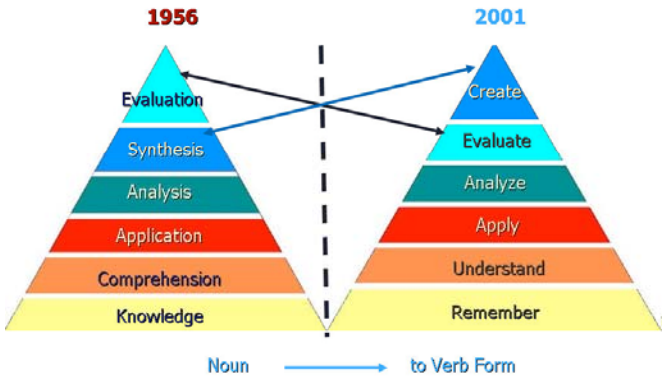
The Knowledge Dimension

	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						
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						
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						
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						

28

(Anderson & Krathwohl, 2001).

Changes to Bloom's



http://www.uwsp.edu/education/lwilson/curric/newtaxonomy.htm

Dee Fink – Creating Significant Learning Experiences

A TAXONOMY OF SIGNIFICANT LEARNING

Cognitive

1. Foundational Knowledge

- "Understand and remember" learning

  For example: facts, terms, formulae, concepts, principles, etc.

2. Application

- Thinking: critical, creative, practical (problem-solving, decision-making)
- Other skills

  For example: communication, technology, foreign language
- Managing complex projects

3. Integration

- Making "connections" (i.e., finding similarities or interactions) . . .

  Among: ideas, subjects, people

Affective

4. Human Dimensions

- Learning about and changing one's SELF
- Understanding and interacting with OTHERS

5. Caring

- Identifying/changing one's feelings, interests, values

Meta

6. Learning How to Learn

- Becoming a better student
- Learning how to ask and answer questions
- Becoming a self-directed learner

SOLO Taxonomy

- The **Structure of Observed Learning Outcome** (**SOLO**) model consists of 5 levels of understanding
  - **Pre-structural** - The task is not attacked appropriately; the student hasn't really understood the point and uses too simple a way of going about it.
  - **Uni-structural** - The student's response only focuses on one relevant aspect.
  - **Multi-structural** - The student's response focuses on several relevant aspects but they are treated independently and additively. Assessment of this level is primarily quantitative.
  - **Relational** - The different aspects have become integrated into a coherent whole. This level is what is normally meant by an adequate understanding of some topic.
  - **Extended abstract** - The previous integrated whole may be conceptualised at a higher level of abstraction and generalised to a new topic or area.

http://en.wikipedia.org/wiki/Structure_of_Observed_Learning_Outcome

Teaching Teaching and Understanding Understanding

- Biggs SOLO taxonomy
- http://video.google.com/videoplay?docid=-5629273206953884671#

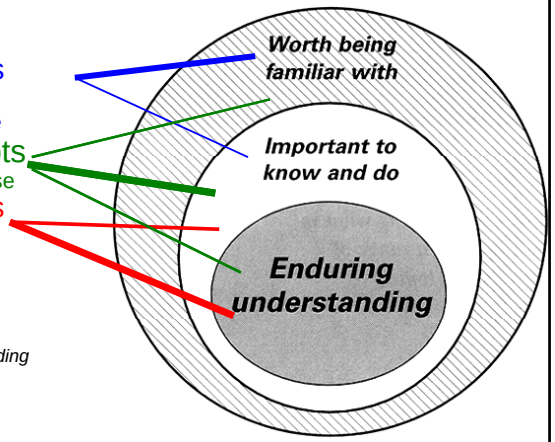
Your turn

- Are you measuring what is most important?
  - Is enduring understanding assessed?
  - Are assessment measures appropriate for enduring understanding?

Curricular Priorities and Assessment Methods

- Assessment Types
  - Traditional quizzes and tests
    - Selected-response
  - Academic Prompts
    - Constructed-response
  - Performance tasks and projects
    - Open-ended
    - Complex
    - Authentic

McTighe & Wiggins (1999) *Understanding by design handbook*. ASCD.



3 Stages of Backward Design

Identify the Desired Results

↓

Determine Acceptable Evidence

↓

Plan Learning Experiences

*Are the desired results, assessments, and learning activities **ALIGNED**?*

*What **activities** will equip students with the needed knowledge and skills?*

*What **materials** and resources will be useful?*

Your turn

- How will you help students master the enduring understanding?
- What kind of learning opportunity can you design?

Session Summary
(Minute Paper)

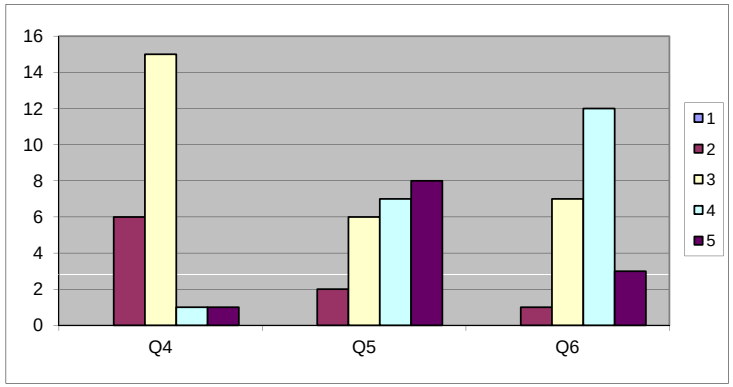
Reflect on the session:

1. Most interesting, valuable, useful thing you learned.
2. Things that helped you learn.
3. Question, comments, suggestions.

4. Pace: Too slow 1 . . . . 5 Too fast
5. Relevance: Little 1 . . . 5 Lots
6. Instructional Format: Ugh 1 . . . 5 Ah

37

MOT 8221 – Spring 2011 – Session 1 (3/25/11)



Q4 – Pace: Too slow 1 . . . . 5 Too fast (2.9)
Q5 – Relevance: Little 1 . . . 5 Lots (3.9)
Q6 – Format: Ugh 1 . . . 5 Ah (3.7)