Introduction to Cooperative Learning

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Lilly Teaching Seminar
Michigan State University
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Reflection and Dialogue

• Individually reflect on Effective, Interactive Strategies for Facilitating Learning. Write for about 1 minute
  – Context? Subject, Year, School/Department
  – Structure/Procedure?
  – Outcome? Evidence of Success
• Discuss with your neighbor for about 3 minutes
  – Select Story, Comment, Question, etc. that you would like to present to the whole group if you are randomly selected
Session Objectives

• Participants will be able to:
  – Describe key features of effective, interactive strategies for facilitating learning
  – Summarize research on How People Learn (HPL)
  – Describe key features of the Understanding by Design (UbD) process – Content (outcomes) – Assessment – Pedagogy
  – Explain key features of and rationale for Cooperative Learning
  – Identify connections between cooperative learning and desired outcomes of courses and programs
• Participants will begin applying key elements to the design on a course, class session or learning module

Seven Principles for Good Practice in Undergraduate Education

• Good practice in undergraduate education:
  – Encourages student-faculty contact
  – Encourages cooperation among students
  – Encourages active learning
  – Gives prompt feedback
  – Emphasizes time on task
  – Communicates high expectations
  – Respects diverse talents and ways of learning

Chickering & Gamson, June, 1987
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**

<table>
<thead>
<tr>
<th>Science of Instruction (UbD)</th>
<th>No</th>
<th>Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good Theory/ Poor Practice</td>
<td></td>
<td></td>
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<tr>
<td>Good Theory &amp; Good Practice</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good Practice/ Poor Theory</td>
<td></td>
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</tr>
</tbody>
</table>


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

Understanding by Design

Stage 1. Identify Desired Results
• Enduring understanding
• Important to know and do
• Worth being familiar with

Stage 2. Determine Acceptable Evidence

Stage 3. Plan Learning Experiences and Instruction
Overall: Are the desired results, assessments, and learning activities ALIGNED?


---

Content-Assessment-Pedagogy (CAP) Design Process Flowchart

Start

Context

Content

Assessment

Pedagogy

Backward Design

C & A & P Alignment?

Yes

No

End

UdB - 3 Stages of Backward Design

Identify the Desired Results

Determine Acceptable Evidence

Plan Learning Experiences

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

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 uncoverage?
• Are the topics big ideas embedded in facts, skills and activities?

Streveler, Smith & Pilotte (2012)
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
Pedago-pathologies

Amnesia

Fantasia

Inertia

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

What do we do about these pathologies?

- **Activity** – Engage learners in meaningful and purposeful activities
- **Reflection** – Provide opportunities
- **Collaboration** – Design interaction
- **Passion** – Connect with things learners care about

Student Engagement Research Evidence

• Perhaps the strongest conclusion that can be made is the least surprising. Simply put, the greater the student’s involvement or engagement in academic work or in the academic experience of college, the greater his or her level of knowledge acquisition and general cognitive development …(Pascarella and Terenzini, 2005).

• Active and collaborative instruction coupled with various means to encourage student engagement invariably lead to better student learning outcomes irrespective of academic discipline (Kuh et al., 2005, 2007).

Cooperative Learning

- 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 is instruction that involves people working in teams to accomplish a common goal, under conditions that involve both positive interdependence (all members must cooperate to complete the task) and individual and group accountability (each member is accountable for the complete final outcome).

Key Concepts

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


Cooperative Learning Research Support


- 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
Informal Cooperative Learning

Active Learning: Cooperation in the College Classroom

- **Informal** Cooperative Learning Groups
- **Formal** Cooperative Learning Groups
- **Cooperative Base** Groups

See Cooperative Learning Handout (CL College-804.doc)
Book Ends on a Class Session

1. Advance Organizer
2. Formulate-Share-Listen-Create (Turn-to-your-neighbor) -- repeated every 10-12 minutes
3. Session Summary (Minute Paper)
   1. What was the most useful or meaningful thing you learned during this session?
   2. What question(s) remain uppermost in your mind as we end this session?
   3. What was the "muddiest" point in this session?
Formulate-Share-Listen-Create

Informal Cooperative Learning Group
Introductory Pair Discussion of a

FOCUS QUESTION

1. Formulate your response to the question **individually**
2. Share your answer with a partner
3. Listen carefully to your partner's answer
4. Work together to Create a new answer through discussion

Informal CL (Book Ends on a Class Session) with Concept Tests

Physics
- Peer Instruction
  - Peer Instruction – www.prenhall.com
  - Richard Hake – http://www.physics.indiana.edu/~hake/

Chemistry
- Chemistry ConcepTests - UW Madison
  - www.chem.wisc.edu/~concept
- Video: Making Lectures Interactive with ConcepTests
  - ModularChem Consortium – http://mc2.cchem.berkeley.edu/

STEMTEC

Harvard – Derek Bok Center
- Thinking Together & From Questions to Concepts: Interactive Teaching in Physics
  - www.fas.harvard.edu/~bok_cen/
Conceptual Understanding

http://groups.physics.umn.edu/physed/Research/MNModel/FCI.html
Physics (Mechanics) Concepts: The Force Concept Inventory (FCI)

• A 30 item multiple choice test to probe student's understanding of basic concepts in mechanics.
• The choice of topics is based on careful thought about what the fundamental issues and concepts are in Newtonian dynamics.
• Uses common speech rather than cueing specific physics principles.
• The distractors (wrong answers) are based on students' common inferences.

Workshop Biology

Traditional passive lecture vs. “Workshop biology”

Source: Udovic et al. 2002
Biology

Informal Cooperative Learning Groups

Can be used at any time
Can be short term and ad hoc
May be used to break up a long lecture
Provides an opportunity for students to process material they have been listening to (Cognitive Rehearsal)
Are especially effective in large lectures
Include "book ends" procedure
Are not as effective as Formal Cooperative Learning or Cooperative Base Groups

Strategies for Energizing Large Classes: From Small Groups to Learning Communities:

Jean MacGregor, James Cooper, Karl Smith, Pamela Robinson

New Directions for Teaching and Learning, No. 81, 2000.
Jossey-Bass

Informal Cooperative Learning Planning Form

<table>
<thead>
<tr>
<th>DESCRIPTION OF THE LECTURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Lecture Topic:</td>
</tr>
<tr>
<td>2. Objectives (Make Understandings Students Need To Have By The End Of The Lecture):</td>
</tr>
<tr>
<td>3. Time Needed:</td>
</tr>
<tr>
<td>4. Method For Assigning Students To Pairs Or Triads:</td>
</tr>
<tr>
<td>5. Method Of Changing Partners Quickly:</td>
</tr>
<tr>
<td>6. Materials Needed:</td>
</tr>
<tr>
<td>7. Transcripts of Lessons to be Discussed and Activities for Students to Use:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ADVANCED ORGANIZER QUESTIONS (s)</th>
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<tbody>
<tr>
<td>Questions should be aimed at promoting advanced organizing of what the students know about the topic to be processed and establishing expectations as to what the lesson will cover:</td>
</tr>
<tr>
<td>1.</td>
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<tr>
<td>2.</td>
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<tr>
<td>3.</td>
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<table>
<thead>
<tr>
<th>COGNITIVE REHEARSAL QUESTIONS</th>
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<tbody>
<tr>
<td>Let the specific question to be asked every 10 to 15 minutes to ensure that participants understand and process information being provided. Students should use the framework, share, discuss, and create questions.</td>
</tr>
<tr>
<td>1.</td>
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<tr>
<td>2.</td>
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<td>3.</td>
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<tr>
<td>4.</td>
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<table>
<thead>
<tr>
<th>SUMMARY QUESTIONS (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Give an ending discussion task and require students to form a question, one that they could act as a question, and that they could use a question. The question should be asked for a summary, evaluate, or review of the material presented or period the next class session.</td>
</tr>
<tr>
<td>1.</td>
</tr>
<tr>
<td>2.</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>CELEBRATE STUDENTS' HARD WORK</th>
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</thead>
<tbody>
<tr>
<td>1.</td>
</tr>
<tr>
<td>2.</td>
</tr>
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</table>
Active Learning: Cooperation in the College Classroom

- **Informal** Cooperative Learning Groups
- **Formal** Cooperative Learning Groups
- Cooperative **Base** Groups

See Cooperative Learning Handout (CL College-804.doc)

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**Formal Cooperative Learning Task Groups**
Professor's Role in Formal Cooperative Learning

1. Specifying Objectives
2. Making Decisions
3. Explaining Task, Positive Interdependence, and Individual Accountability
4. Monitoring and Intervening to Teach Skills
5. Evaluating Students' Achievement and Group Effectiveness

Formal Cooperative Learning – Types of Tasks

1. Jigsaw – Learning new conceptual/procedural material
2. Peer Composition or Editing
3. Reading Comprehension/Interpretation
4. Problem Solving, Project, or Presentation
5. Review/Correct Homework
6. Constructive Controversy
7. Group Tests
Challenge-Based Learning

- Problem-based learning
- Case-based learning
- Project-based learning
- Learning by design
- Inquiry learning
- Anchored instruction

John Bransford, Nancy Vye and Helen Bateman. Creating High-Quality Learning Environments: Guidelines from Research on How People Learn

Challenge-Based Instruction with the Legacy Cycle

[Diagram of the Legacy Cycle]

https://repo.vanth.org/portal/public-content/star-legacy-cycle/star-legacy-cycle
Problem-Based Learning

Problem posed

Apply it

Learn it

Identify what we need to know

Problem-Based Cooperative Learning

At M.I.T., Large Lectures Are Going the Way of the Blackboard
http://web.mit.edu/edtech/casestudies/teal.html#video

http://www.ncsu.edu/PERSCALEup.html
Inside an Active Learning Classroom

• STSS in University of Minnesota

http://vimeo.com/andyub/activeclassroom

“I love this space! It makes me feel appreciated as a student, and I feel intellectually invigorated when I work and learn in it.”
The Motivation to Learn Begins with a Problem

In a problem-based learning (PBL) model, students engage in solving challenging problems and to achieve mastery and to achieve their goals. PBL is about students acquiring discipline-specific knowledge to solve real-world problems—the motivation to solve a problem becomes the motivation to learn.

PBL@UD

For more than ten years, the Leaders and Fellows of the Institute for Transforming Undergraduate Education (ITUE) have encouraged the adoption of student-centered and active classroom pedagogies in particular in use of PBL in the undergraduate classroom. Ongoing efforts to develop PBL workshops are held for faculty and students to enhance their understanding of PBL.

Penn State at Hershey: Certificate of Excellence

The Theodore K. Stavros Award was created to reward and reward successful, innovative faculty development programs that enhance undergraduate teaching. PBL is a recipient of the newsletter certificate of excellence for its work in implementing problem-based learning in the classroom.

http://www.udel.edu/inst/

Duke School of Medicine embraces Team-Based Learning

The Duke University School of Medicine has begun incorporating team-based learning into its medical curriculum to help better prepare future physicians for the changing landscape of health care, which will become increasingly team-based and collaborative.

http://www.youtube.com/watch?v=gW_M426V2E0&feature=related
Problem-Based Cooperative Learning

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Civil Engineering - University of Minnesota
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http://www.ce.umn.edu/~smith

Estimation Exercise

First Course Design Experience
UMN – Institute of Technology

• Thinking Like an Engineer
• Problem Identification
• Problem Formulation
• Problem Representation
• Problem Solving

Problem-Based Learning
Problem Based Cooperative Learning Format

**TASK:** Solve the problem(s) or Complete the project.

**INDIVIDUAL:** Estimate answer. Note strategy.

**COOPERATIVE:** One set of answers from the group, strive for agreement, make sure everyone is able to explain the strategies used to solve each problem.

**EXPECTED CRITERIA FOR SUCCESS:** Everyone must be able to explain the strategies used to solve each problem.

**EVALUATION:** Best answer within available resources or constraints.

**INDIVIDUAL ACCOUNTABILITY:** One member from your group may be randomly chosen to explain (a) the answer and (b) how to solve each problem.

**EXPECTED BEHAVIORS:** Active participating, checking, encouraging, and elaborating by all members.

**INTERGROUP COOPERATION:** Whenever it is helpful, check procedures, answers, and strategies with another group.
Cooperative Base Groups

- Are Heterogeneous
- Are Long Term (at least one quarter or semester)
- Are Small (3-5 members)
- Are for support
- May meet at the beginning of each session or may meet between sessions
- Review for quizzes, tests, etc. together
- Share resources, references, etc. for individual projects
- Provide a means for covering for absentees
Designing and Implementing Cooperative Learning

- Think like a designer
- Ground practice in robust theoretical framework
- Start small, start early and iterate
- Celebrate the successes; problem-solve the failures
The Instructor’s Role in Cooperative Learning

Make Pre-Instructional Decisions

Specific Academic and Social Objectives: How objectives have been set, how they contribute to the development of students, and how they affect the learning environment.

Designing Group Task: Learning groups should be small groups of three or four members. These groups can be mixed, with three members from the same class and one from a different class. This helps to maintain a balance, and it encourages different perspectives.

Applying Strategy: The strategy should be designed to enhance student interaction. This can be achieved through the use of group discussions, small group activities, and cooperative learning strategies.

Monitor and Evaluate

Incorporate Cooperative Strategies: These strategies can be incorporated into the classroom environment by using group activities, small group discussions, and cooperative learning strategies. This helps to maintain a balance, and it encourages different perspectives.

Evaluating and Processing

Evaluate Student Learning: Assess the quality and quantity of student learning. This includes feedback to the students.

Provide Group Feedback: Each group should receive feedback, whether it was successful or not. This helps to improve the quality of student learning. However, it is important to provide constructive feedback to the students.

Cooperative Lesson Planning Form

Lesson Title: ____________

Objectives:

Social Skills:

Pre-instructional Decisions:

Group Size: _________ Method of Ongoing Evaluation: _________

Role:

Materials:

Other:

Explain Task and Cooperative Goal Structure:

Task:

1. Criteria for Success:

2. Positive Interdependence:

3. Common Goal:

4. Individual Accountability:

5. Reciprocal Peer Review:

6. Equal Group Participation:

Cooperative Lesson Planning Form: This form helps to organize the planning of a cooperative lesson. It includes the lesson title, objectives, social skills, pre-instructional decisions, role, materials, and task. This helps to ensure that the lesson is well-planned and effective.
The American College Teacher:
National Norms for 2007-2008

<table>
<thead>
<tr>
<th>Methods Used in “All” or “Most”</th>
<th>All – 2005</th>
<th>All – 2008</th>
<th>Assistant - 2008</th>
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<tbody>
<tr>
<td>Cooperative Learning</td>
<td>48</td>
<td>59</td>
<td>66</td>
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<tr>
<td>Group Projects</td>
<td>33</td>
<td>36</td>
<td>61</td>
</tr>
<tr>
<td>Grading on a curve</td>
<td>19</td>
<td>17</td>
<td>14</td>
</tr>
<tr>
<td>Term/research papers</td>
<td>35</td>
<td>44</td>
<td>47</td>
</tr>
</tbody>
</table>

http://www.heri.ucla.edu/index.php

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
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)
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

The Cognitive Process Dimension

<table>
<thead>
<tr>
<th>Factual Knowledge – The basic elements that students must know to be acquainted with a discipline or solve problems in it.</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Knowledge of terminology</td>
</tr>
<tr>
<td>b. Knowledge of specific details and elements</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Conceptual Knowledge – The interrelationships among the basic elements within a larger structure that enable them to function together.</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Knowledge of classifications and categories</td>
</tr>
<tr>
<td>b. Knowledge of principles and generalizations</td>
</tr>
<tr>
<td>c. Knowledge of theories, models, and structures</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Procedural Knowledge – How to do something, methods of inquiry, and criteria for using skills, algorithms, techniques, and methods.</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Knowledge of subject-specific skills and algorithms</td>
</tr>
<tr>
<td>b. Knowledge of subject-specific techniques and methods</td>
</tr>
<tr>
<td>c. Knowledge of criteria for determining when to use appropriate procedures</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Metacognitive Knowledge – Knowledge of cognition in general as well as awareness and knowledge of one's own cognition.</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Strategic knowledge</td>
</tr>
<tr>
<td>b. Knowledge about cognitive tasks, including appropriate contextual and conditional knowledge</td>
</tr>
<tr>
<td>c. Self-knowledge</td>
</tr>
</tbody>
</table>

Remember Understand Apply Analyze Evaluate Create

66 (Anderson & Krathwohl, 2001).
A Model of Learning Objectives

Based on
A Taxonomy for Learning, Teaching, and Assessing:
A Revision of Bloom's Taxonomy of Educational Objectives

Among other modifications, Anderson and Krathwohl's (2001) version of the original Bloom's taxonomy (Bloom & Krathwohl, 1956) modifies the cognitive domain in the taxonomy of the Cognitive Process Dimensions and the Knowledge Dimensions. This document offers a three-dimensional representation of the revised taxonomy of the cognitive domain.

Although the Cognitive Process and Knowledge dimensions are represented as hierarchical stages, the distinctions between categories are not absolute in terms of content knowledge and procedural knowledge. As one moves through the levels of the knowledge dimension, the nature of the cognitive skills involved in learning and applying knowledge also changes. The skills required to accomplish the higher-order thinking skills may require thinking skills that are not as complex as those that involve lower-order thinking skills.

The Knowledge Dimension classifies four types of knowledge that learners may be expected to acquire or construct—ranging from concrete to abstract (Table 1).

Table 1. The Knowledge Dimension — major types and subtypes

<table>
<thead>
<tr>
<th>concrete knowledge</th>
<th>conceptual knowledge</th>
<th>procedural knowledge</th>
<th>abstract knowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td>factual</td>
<td>knowledge of concepts and categories</td>
<td>knowledge of subject-specific skills and algorithms</td>
<td>strategic knowledge</td>
</tr>
<tr>
<td>knowledge of specific details and elements</td>
<td>knowledge of principles and generalizations</td>
<td>knowledge of specific techniques and methods</td>
<td>knowledge of criteria for determining when to use appropriate procedures</td>
</tr>
<tr>
<td>procedural</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>knowledge of how to apply and implement the knowledge to various contexts</td>
<td>knowledge of how to apply and implement the knowledge in various contexts</td>
<td></td>
<td></td>
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<tr>
<td>abstract</td>
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</tr>
<tr>
<td>knowledge of how to apply and implement the knowledge to novel contexts</td>
<td>knowledge of how to apply and implement the knowledge in novel contexts</td>
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</tr>
</tbody>
</table>

*Strategic knowledge and metacognitive knowledge highlight the importance of learning to learn and to think critically.*

http://www.celt.iastate.edu/pdfs-docs/teaching/RevisedBloomsHandout.pdf
Facets of Understanding

When we truly understand, we
Can explain - cognitive
Can interpret - cognitive
Can apply - cognitive
Have perspective - affective
Can empathize - affective
Have self-knowledge - metacognitive
Dee Fink – Creating Significant Learning Experiences

A TAXONOMY OF SIGNIFICANT LEARNING

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

4. Human Dimensions
   - Learning about and changing one's SELF
   - Understanding and interacting with OTHERS

5. Caring
   - Identifying/Changing one's feelings, interests, values

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.

Teaching Teaching and Understanding Understanding

- Biggs SOLO taxonomy

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

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

### Resources

- **Design Framework – How People Learn (HPL) & Understanding by Design (UdB) Process**

- **Content Resources**

- **Cooperative Learning**
  - Cooperative Learning (Johnson, Johnson & Smith) - Smith web site – [www.ce.umn.edu/~smith](http://www.ce.umn.edu/~smith)

- **Other Resources**
  - University of Delaware PBL web site – [www.udel.edu/pbl](http://www.udel.edu/pbl)
  - PKAL – Pedagogies of Engagement – [http://www.pkal.org/Activities/PedagogiesOfEngagementSummit.cfm](http://www.pkal.org/Activities/PedagogiesOfEngagementSummit.cfm)