Evidence-Based Practices for Innovative Education

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Overview

• Keynote – Evidence-Based Practices for Innovative Education
  – Welcome & Overview
  – Cooperative Learning Basics
  – Course Design Foundations
• Workshop – Design and Implementation of Active and Cooperative Learning
  – Informal Cooperative Learning
    • Book Ends on a Class Session
  – Formal Cooperative Learning
    • Problem-Based Cooperative Learning
Clicker Usage

1. Never
2. Occasionally
3. Frequently
4. Always

Participant Learning Goals (Objectives)

- Describe key features of the Understanding by Design and How People Learn
- Describe key features of Cooperative Learning
- Explain rationale for Pedagogies of Engagement, especially Cooperative Learning & Challenge Based Learning
- Apply cooperative learning to classroom practice
- Identify connections between cooperative learning and desired outcomes of courses and programs
Reflection and Dialogue

- Individually reflect on your mental image of an innovative teacher. Write for about 1 minute.
  - Jot down words or phrases
  - Construct a figure or diagram
- Discuss with your neighbor for about 2 minutes
  - Describe your mental image and talk about similarities and differences
  - Select one Element, Image, Comment, Story, etc. that you would like to present to the whole group if you are randomly selected
- Whole group discussion

Teacher Mental Images About Teaching - Axelrod (1973)

<table>
<thead>
<tr>
<th>Mental Image</th>
<th>Motto</th>
<th>Characteristics</th>
<th>Disciplines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Content</td>
<td>I teach what I know</td>
<td>Pour it in, Lecture</td>
<td>Science, Math</td>
</tr>
<tr>
<td>Instructor</td>
<td>I teach what I am</td>
<td>Modeling, Demonstration</td>
<td>Many</td>
</tr>
<tr>
<td>Student – Cognitive Development</td>
<td>I train minds</td>
<td>Active Learning, Discussion</td>
<td>English, Humanities</td>
</tr>
<tr>
<td>Student – Development of Whole Person</td>
<td>I work with students as people</td>
<td>Motivation, Self-esteem</td>
<td>Basic Skills Teachers</td>
</tr>
</tbody>
</table>

Process Metallurgy

- Dissolution Kinetics – liquid-solid interface
- Iron Ore Desliming – solid-solid interface
- Metal-oxide reduction roasting – gas-solid interface
Dissolution Kinetics

- Theory – Governing Equation for Mass Transport
- Research – rotating disk
- Practice – leaching of silver bearing metallic copper

\[ (\nabla c \cdot v) = D \nabla^2 c \]

\[ v_y \frac{dc}{dy} = D \frac{d^2 c}{dy^2} \]

First Teaching Experience

- Practice – Third-year course in metallurgical reactions – thermodynamics and kinetics
Engineering Education

- Practice – Third-year course in metallurgical reactions – thermodynamics and kinetics
- Research – ?
- Theory – ?

University of Minnesota College of Education
Social, Psychological and Philosophical Foundations of Education

- Statistics, Measurement, Research Methodology
- Assessment and Evaluation
- Learning and Cognitive Psychology
- Knowledge Acquisition, Artificial Intelligence, Expert Systems
- Development Theories
- Motivation Theories
- Social psychology of learning – student – student interaction
Cooperative Learning

- Research – Randomized Design Field Experiments
- Practice – Formal Teams/Professor’s Role
Cooperative Learning

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

[*First edition 1991]

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
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


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**What is your experience with cooperative learning?**

1. Little 1
2. Between 1&3
3. Moderate 3
4. Between 3&5
5. Extensive 5
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

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).

Small-Group Learning: Meta-analysis


Small-group (predominantly cooperative) learning in postsecondary science, mathematics, engineering, and technology (SMET). 383 reports from 1980 or later, 39 of which met the rigorous inclusion criteria for meta-analysis.

The main effect of small-group learning on achievement, persistence, and attitudes among undergraduates in SMET was significant and positive. Mean effect sizes for achievement, persistence, and attitudes were 0.51, 0.46, and 0.55, respectively.

“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
What is your experience with course (re)design?

1. Little 1
2. Between 1&3
3. Moderate 3
4. Between 3&5
5. Extensive 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?
### Design Foundations

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

**Sources:**

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**What is your level familiarity with learning theories (e.g., HPL) & instruction theories (e.g., UbD)?**

1. Low 1
2. Between 1&3
3. Moderate 3
4. Between 3&5
5. High 5
1. Students prior knowledge can help or hinder learning
2. How students 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
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

<table>
<thead>
<tr>
<th>Start</th>
</tr>
</thead>
<tbody>
<tr>
<td>Context</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Content</td>
</tr>
<tr>
<td>Assessment</td>
</tr>
<tr>
<td>Pedagogy</td>
</tr>
<tr>
<td>C &amp; A &amp; P Alignment?</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>End</td>
</tr>
</tbody>
</table>

Backward Design

Streveler, Smith & Pilotte (2011)

Understanding by Design (Wiggins & McTighe, 2005)

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?

UdB 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?
Pedagogies of Engagement

The Active Learning Continuum

Make the lecture active → Informal Group Activities → Structured Team Activities → Problems Drive the Course

Instructor Centered → Active Learning → Collaborative Learning → Cooperative Learning → Problem-Based Learning → Student Centered

Prince, M. (2010). NAE FOEE

My work is situated here – Cooperative Learning & Challenge-Based 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)

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Book Ends on a Class Session

Cooperative Learning Adopted
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>
</tr>
</thead>
<tbody>
<tr>
<td>Cooperative Learning</td>
<td>48</td>
<td>59</td>
<td>66</td>
</tr>
<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

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)
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 Academic Controversy
7. Group Tests
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/PER/scaleup.html

http://mediamill.cla.umn.edu/mediamill/embed/78755

http://www.youtube.com/watch?v=lfT_hoiuY8w
http://www.udel.edu/inst/

Afternoon Session Preview

• Design and Implementation of Active and Cooperative Learning
  – Pedagogies of Engagement – Cooperative Learning and Challenge Based Learning
  – Formal Cooperative Learning
    • Instructor’s Role

• Preparation for Afternoon Session
  – Reflect on your use of student teams
    • List things that are working well
    • List problems you’ve encountered
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

Pace

1. Too slow 0%
2. Slow
3. Ok
4. Fast
5. Too fast

0 of 39
Relevance

1. Very Little 0%
2. Little
3. Some
4. Quite a bit
5. Lots

Instructional Format

0% 1. Ugh
0% 2. Huh
0% 3. Hmm
0% 4. Yeah
0% 5. Ah
College Teaching: What do we know about it?

- Five assertions about what we know about college teaching
  - Good teaching makes a difference
  - Teachers vary markedly
  - Some characteristics/methods are present in all good teaching
  - Teaching can be evaluated and rewarded
  - There is ample room for improvement.

- K. Patricia Cross, 1991 ASEE ERM Distinguished Lecture
Four factors in good teaching, based on student ratings*:

- Skill. Communicates in an exciting way.
- Rapport. Understands and emphasizes with students.
- Structure. Provides guidance to course and material.
- Load. Requires moderate work load.

*Student ratings of teaching are consistent (with other measures), unbiased, and useful. Students agree on good teaching and their views are consistent with faculty.

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.unm.edu/~smith

- Other Resources
  - University of Delaware PBL web site ~ www.udel.edu/pbl
Thank you!

An e-copy of this presentation is posted to:
http://www.ce.umn.edu/~smith/links.html

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