It is strange that we expect students to learn, yet seldom teach them anything about learning. **We expect students to solve problems, yet seldom teaching them anything about problem solving.** And, similarly, we sometimes require students to remember a considerable body of material, yet seldom teach them the art of memory. It is time we Made up for this lack...

Learning Requires

deliberate

distributed

practice


Key Implications

Deliberate

Attention must be paid

Attention and processing power = cognitive load (bandwidth)

• LIMITED – need to be careful how one uses the learner’s bandwidth
  • Link to Curricular Priorities
  • Continuous partial attention

• Reflection is needed
  • Need for feedback
    • Link to assessment
Key Implications

Distributed

- Repetition over time
  - Spaced vs. massed practice*
  - Spiral curriculum
- Multiple modes of input
  - Visual
  - Audio
  - Kinesthetic
  - Self-explanation
  - Explaining to others


Key Implications

Practice what you want to learn

Active (Attentive) – doing something
Constructive – adding to your prior knowledge
Interactive – working with others to add to your prior knowledge

Session Layout

Welcome & Overview

Three BIG IDEAS (Enduring Outcomes)
- Streamlined Course Design
- Alignment of Outcomes, Assessment and Instruction
- Interactive Learning

Streamlined Course Design
- Course outcomes planning form
- Course Concept Map

Assessment Overview
- Types of assessment
- Writing learning objectives
- Mapping objectives on a taxonomy exercise

Interactive (Cooperative) Learning
- Description & Rationale
- Cooperative Learning
- Types of Cooperative Learning
- Informal Cooperative Learning planning exercise

Implementing Evidence-Based Instructional Practices
- Practice
- Examples
- Applications

Big Ideas (Enduring Outcomes)

- Streamlined Course Design
- Alignment of Outcomes, Assessment and Instruction
- Interactive Learning
Streamlined Course Design

Streamlined Course Design is a guided process that is based on the engineering design process.

The end product Streamlined Course Design is a course where what is learned, how that learning is measured, and the learning environment are all aligned.

Why Streamline?

• Aligned courses — students are learning what “matters” and you have evidence about their learning

• Increased student learning — about the things that matter

• Increased satisfaction by instructors and students about their experience in the course
Version 0 - What is the Common Instructional Design Approach?

Choose Text → Identify Chapters Covered → Develop Lectures → Create Exams

Our Assertion

Course design should follow the engineering design process

Our next questions:
- What is the engineering design process?
- How does course design map to the engineering design process?
Curricular Priorities: What are they?

First – how do you want your students to be different when they leave the class? What should they know, be able to do, care about?

Second – how can you rank what you listed in #1 as most important?

Wiggins and McTighe called these “curricular priorities”
   ◦ Enduring outcomes – enduring long after the course is over
   ◦ Important to know – KSA needed to arrive at the enduring outcomes
   ◦ Good to be familiar with – good if they can recognize, but nothing vital

Note these are not necessarily written as LEARNING OBJECTIVES (that is a separate step).
Curricular Priorities

Categorize outcomes into three levels

Good to be familiar with

Important to know

Enduring understandings outcomes

From Wiggins and McTighe

How to Determine Curricular Priorities

Big ideas:
◦ What lies at the heart of the discipline?
◦ What do professionals/experts do?

Essential questions:
◦ What questions do you want your students to ask as they learn the material?

What are the guiding concepts and how do those concepts relate to one another?
◦ A graphic like a concept map is one way to discover relationships
Engineering Entrepreneurship
Curricular Priorities

Enduring Understanding
Entrepreneurship is the intersection of a good idea, a great execution plan, and a self-directed and determined work ethic.

Important to Know & Do
Describe the entrepreneurial role of small business.
Demonstrate ability to find credible data and resources necessary to develop a detailed marketing, financial and operations plan.
Demonstrate ability to complete a business plan.

Worth being Familiar with
Forms of ownership, franchising and related business variables.
Functions of management in small business.
Tax laws and small business implications.
Identifying location and determining operational layout.
Business controls related to purchasing, inventory, and line control.
Computer use in small business.
Personnel functions related to the entrepreneurial firm.
Marketing concepts including sales and distribution.
Govt. laws and regulations.

Curricular Priorities Worksheet

1. List curricular priorities of the course you want to (re)design – see Handout
   1. Enduring outcomes
   2. Important to know outcomes
   3. Good to be familiar with outcomes

2. Create a concept map of the course that includes enduring outcomes, important to know, and good to be familiar with items.
What are concept maps and why use them?

What are concept maps?
- Concept maps are graphical tools for organizing and representing knowledge (http://cmap.ihmc.us).

Why use concept maps?
- They are a tool for helping you think about how the concepts in your target domain are connected.
- They help you discover what is most important — thus are useful for determining curricular priorities and for identifying difficult or threshold concepts.

Concept Maps Software Tools

FREE

Cmap Tools (http://cmap.ihmc.us)
- Institute for Human &Machine Cognition
- Free downloadable program
- Site also has links to instructional videos on how to use Cmap

Commercial software with free trials

Inspiration
- http://www.inspiration.com/
Example of concept maps

Engineering Entrepreneurship
First Concept Map
Engineering Entrepreneurship
Second Iteration of Concept Map

Engineering Entrepreneurship
Third Iteration of Concept Map
Learning Objectives = the bridge between content and assessment

WHY?
○ Learning objectives are the mechanism for making the learning MEASURABLE. So you CAN assess it!

What? Learning objectives are statements that are:
○ Specific
○ Measurable (Describable)
○ Attainable
○ Relevant
○ Time-bound

Why assess?

Designer’s perspective:
○ Assessment is the measure YOU need to know if your design is working as you would like it to.
○ Analogous to the measuring against the specs of a technical design.
○ Writing learning objective is like writing the specs.
Why assess?

Learners’ perspective
◦ How will LEARNERS know they learned the material?
◦ How will LEARNERS reflect on what they have practiced?
◦ How will LEARNERS be able to practice what they need to learn?

Assessment as:
◦ A form of learning
◦ A form of reflection
◦ A form of deliberate, distributed practice

Types of Assessment

1. **Diagnostic Assessment**
   Conducted at the beginning of an instructional unit, course, semester. . . to determine the present level of knowledge, skill, interest. . . of a student, group or class.

2. **Formative Assessment**
   Conducted periodically throughout the instructional unit. . . to monitor progress and provide feedback toward learning goals.

3. **Summative Assessment**
   Conducted at the end of an instructional unit or semester to judge the quality and quantity of student achievement and/or the success of the instructional unit.
Making Assessments Meaningful

1. To be meaningful, assessment has to have a purpose that is significant

2. Meaningful assessments provide a direction and road map for future efforts to learn.

Writing Learning Objectives

1. WHEN DO YOU WRITE LEARNING OBJECTIVES?

2. HOW DO YOU WRITE LEARNING OBJECTIVES?

3. EXAMPLES

4. NOW YOU TRY!
When Do You Write Learning Objectives

Learning Objectives                     Curricular Priorities

- **Optional**
- **Important**
- **Must be present!**

Constructing Learning Objectives
*Using Verb-Noun Format*

- Alignment of CONTENT and ASSESSMENT
- The VERB should be appropriate for the desired levels of Knowledge and Cognitive Processes
- Acceptable evidence of learning
- Concrete, Observable, Measurable
At the end of this course, students will:

• Understand the importance of contextual features

• Understand the importance of contextual features for product design

• Explain in plain language why is it important to consider contextual features in the design of a product

• Design (a product X) for (a particular user/population Y)

Activity: Writing Learning Objectives for your Curricular Priorities

Total Activity Time: ~15 minutes
Part 1: Individual Exercise (5 minutes)
Part 2: Small Group Discussion (10 minutes)
Activity Part I (5 Minutes):
Write your Learning Objectives (LO)s

On your own, write LOs for your *enduring outcomes* first. If time allows, try to write one LO for an *important to know* piece of your curricular priorities.

Activity Part II (10 Minutes)
Discuss with your Group

Share your learning objectives (LOs) with your breakout group. Do your LOs seem *SMART* and well-written to your peers?
Question

Do you use a taxonomy of learning objectives? If yes, which one?

Taxonomies of Learning Objectives

What is a taxonomy?
How do you use them?
Why are they useful?
When do you use them?
Taxonomies of Learning Objectives

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).

Taxonomy of significant learning (Fink, 2003)

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

Facets of understanding (Wiggins & McTighe, 1998)

Anderson and Krathwohl taxonomy

AN UPDATED VERSION OF BLOOM’S TAXONOMY
Revised Bloom’s Taxonomy

**The Cognitive Process Dimension** represents a continuum of increasing cognitive complexity—from lower order thinking skills to higher order thinking skills. Anderson and Krathwohl (2001) identify nineteen specific cognitive processes that further clarify the scope of the six categories (Table 2).

<table>
<thead>
<tr>
<th>lower order thinking skills</th>
<th>apply</th>
<th>analyze</th>
<th>evaluate</th>
<th>create</th>
</tr>
</thead>
<tbody>
<tr>
<td>recognizing, recalling</td>
<td>executing, implementing, using</td>
<td>differentiating, distinguishing, focusing, selecting, organizing</td>
<td>checking, predicting, reflecting</td>
<td>generating, producing, constructing</td>
</tr>
<tr>
<td>interpreting, paraphrasing, representing</td>
<td>summarizing, generalizing, inferring</td>
<td>summarizing, generalizing, inferring</td>
<td>summarizing, generalizing, inferring</td>
<td>summarizing, generalizing, inferring</td>
</tr>
<tr>
<td>translating, classifying, analyzing</td>
<td>summarizing, generalizing, inferring</td>
<td>summarizing, generalizing, inferring</td>
<td>summarizing, generalizing, inferring</td>
<td>summarizing, generalizing, inferring</td>
</tr>
<tr>
<td>selecting, applying, solving</td>
<td>summarizing, generalizing, inferring</td>
<td>summarizing, generalizing, inferring</td>
<td>summarizing, generalizing, inferring</td>
<td>summarizing, generalizing, inferring</td>
</tr>
<tr>
<td>building, making, creating, constructing</td>
<td>summarizing, generalizing, inferring</td>
<td>summarizing, generalizing, inferring</td>
<td>summarizing, generalizing, inferring</td>
<td>summarizing, generalizing, inferring</td>
</tr>
</tbody>
</table>

(Table 2 adapted from Anderson and Krathwohl, 2001, pp. 67-68)

Examples of Objectives that Map to Bloom

1. List the six levels of the revised Bloom’s taxonomy
2. Explain in your own words the first three levels
3. Map the following learning objectives to a level on Bloom’s taxonomy:
   - At the end of the course, students will be able to
     - Solve mass transfer problems using Fick’s law
     - Enumerate the essential components in a control loop
     - Build a functional prototype of a membrane separation system for a set of given operating conditions

Adapted from Michael Prince’s Workshop “How to engineer engineering education”, July 2016
Examples of Objectives that Map to Bloom

4. An instructor wrote the following learning objective for an enduring outcome:
   Classify different forms of assessment into authentic or non authentic
   Does it sound appropriate? Could you improve it?

5. Choose the appropriate level on Bloom’s taxonomy for the outcomes of your course justifying, your choice

6. Write the learning objectives of your course at different levels of Bloom’s taxonomy

Adapted from Michael Prince’s Workshop “How to engineer engineering education”, July 2016

Revised Bloom’s Learning Taxonomy

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</th>
<th>procedural</th>
<th>metacognitive</th>
</tr>
</thead>
<tbody>
<tr>
<td>factual</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>knowledge of terminology</td>
<td>knowledge of classifications 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 subject-specific tactics and methods</td>
<td>knowledge about cognitive tasks, including appropriate contextual and conditional knowledge</td>
</tr>
<tr>
<td>procedural</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>knowledge of theories, models, and structures</td>
<td>knowledge of subject-specific techniques and methods</td>
<td>knowledge of criteria for determining when to use appropriate procedures</td>
<td>self-knowledge</td>
</tr>
</tbody>
</table>

(Table 1 adapted from Anderson and Krathwohl, 2001, p. 46.)

*Metacognitive knowledge is a special case. In this model, metacognitive knowledge is knowledge of [one’s own] cognition and about oneself in relation to various subject matters…” (Anderson and Krathwohl, 2001, p. 44).

Revised Bloom’s Learning Taxonomy

A statement of a learning objective contains a verb (an action) and an object (usually a noun). 

- The verb generally refers to actions associated with the intended cognitive process. 
- The object generally describes the knowledge students are expected to acquire or construct. (Anderson and Krathwohl, 2001) 

In this model, each of the colored blocks shows an example of a learning objective that generally corresponds with each of the various combinations of the cognitive process and knowledge dimensions.

Remember: those are learning objectives—not learning activities.

It may be useful to think of mapping each objective with something like “Students will be able to…”


Mapping Learning Objectives

Example from Ruth Wertz

<table>
<thead>
<tr>
<th>Map of Week 5 Learning Objectives</th>
<th>Cognitive Process Dimension</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>A. Formative Knowledge</td>
<td></td>
</tr>
<tr>
<td>B. Conceptual Knowledge</td>
<td></td>
</tr>
<tr>
<td>C. Procedural Knowledge</td>
<td></td>
</tr>
<tr>
<td>D. Metacognitive Knowledge</td>
<td></td>
</tr>
</tbody>
</table>

(Framework: Anderson & Krathwohl, 2001)

Content:

- [L1] Describe the meaning of the relationship between stress and strain.
- [L2] Define the modulus of elasticity, shear modulus, and Poisson’s ratio.
- [L3] Describe the physical meaning of effective stress.
- [L4] Compute total and effective vertical stresses under hydrostatic and seepage conditions.
- [L5] Estimate induced stresses at a discrete point or along a plane, due to an applied load.

Annotated Example: Map of Weekly Learning Objectives (Annotated Example).docx
Mapping examples

• Classify different dynamic behaviors as the result of physicochemical interactions that can be modeled with computational tools.  
Level 2  
EO

• Select the appropriate control parameters based on the character of the process, as seen through its response to known perturbations.  
Level 4  
ITK

• Design and test controllers with the aid of computational tools.  
Level 6  
EO

Fink

TAXONOMY OF SIGNIFICANT LEARNING OUTCOMES
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

Foundational Knowledge

What key information (e.g., facts, terms, formulae, concepts, principles, relationships, etc.) is/are important for students to understand and remember in the future?

What key ideas (or perspectives) are important for students to understand in this course?
Application

What kinds of thinking are important for students to learn?

- Critical thinking, in which students analyze and evaluate
- Creative thinking, in which students imagine and create
- Practical thinking, in which students solve problems and make decisions

What important skills do students need to gain?

Do students need to learn how to manage complex projects?

Integration

What connections (similarities and interactions) should students recognize and make…:

- Among ideas within this course?
- Among the information, ideas, and perspectives in this course and those in other courses or areas?
- Among material in this course and the students' own personal, social, and/or work life?
Human Dimension

What could or should students learn about *themselves*? What could or should students learn about *understanding others* and/or *interacting with them*?

Caring

What changes/values do you hope students will adopt?
- Feelings?
- Interests?
- Ideas?
Learning-How-to-Learn

What would you like for students to learn about:
◦ how to be good students in a course like this?
◦ how to learn about this particular subject?
◦ how to become a self-directed learner of this subject, i.e., having a learning agenda of what they need/want to learn, and a plan for learning it?

Application of Fink Taxonomy

Joi Mondisa - Developing Self-identity, Confidence, and Community: The NLFN STEM Girls’ Mentoring Program Curricular Project

<table>
<thead>
<tr>
<th>Taxonomy Level</th>
<th>Learning Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foundational Knowledge</td>
<td>Recall at least three specific STEM career opportunities (LO6)</td>
</tr>
<tr>
<td>Integration</td>
<td></td>
</tr>
<tr>
<td>Human Dimension</td>
<td>Describe two personal strengths (LO3)</td>
</tr>
<tr>
<td>Caring</td>
<td></td>
</tr>
<tr>
<td>Learning how to Learn</td>
<td>Feel comfortable working together with others and constructing meaning with others (LO5)</td>
</tr>
<tr>
<td>Application</td>
<td>Create and engage in making a Legos robot in a robotic competition. (LO7)</td>
</tr>
</tbody>
</table>
Learning Objectives and Taxonomies

Further Resources
- Two websites about (1) changes to Bloom’s Taxonomy and (2) the revised Bloom’s Taxonomy
- Fink’s Taxonomy – Self Directed Guide
  - [https://www.deefinkandassociates.com/GuidetoCourseDesignAug05.pdf](https://www.deefinkandassociates.com/GuidetoCourseDesignAug05.pdf)

Activity: Taxonomy Discussion ~ 10 minutes

Please discuss the following questions with your small group:

1. Which taxonomy works better for your project? - Anderson and Krathwohl or Fink and why?
2. How do your learning objectives fit into the taxonomy you have selected?
Matching instruction to your curricular priorities

Essential Questions

Are there useful ways to categorize different kinds of “active” or more student-centered teaching strategies?

How does one decide which kind of activity to use?
Framework for looking at “active” learning

<table>
<thead>
<tr>
<th>ACTIVE–ATTENTIONAL</th>
<th>CONSTRUCTIVE</th>
<th>INTERACTIVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doing something physically</td>
<td>Producing outputs that go beyond presented information</td>
<td>Dialoguing substantively on the same topic, and not ignoring a partner’s contribution</td>
</tr>
<tr>
<td>Engaging activities</td>
<td>Self-construction</td>
<td>Guided-construction</td>
</tr>
<tr>
<td>Attending processes</td>
<td>Creation processes</td>
<td>Joint creation processes</td>
</tr>
</tbody>
</table>

ICAP framework, Michene T.H. Chi

Other papers about ICAP


“Attentional” strategies

Attention is the gateway to learning

However, many of us live in a state of continuous partial attention

Strategies to help your student pay attention are important.

Examples:

◦ Assigning observation roles while watching a live demonstration or video
◦ Asking students to repeat what another student has said
◦ Providing handouts with “fill in the blank” sections

Constructive activities

Research on learning has shown that we learn new information by connecting new information to what we already know (this is called “Constructivism”)

Constructive activities help your students make that bridge between new and previous knowledge

Examples:

◦ Providing an example of a concept or theory
◦ Explaining something in one’s own words
◦ Converting written or numerical information into a diagram or graph
Activity: Developing a constructive learning activity

Total Activity Time: ~15 minutes
Part 1: Individual Exercise (5 minutes)
Part 2: Small Group Discussion (10 minutes)
Part 3: Report out

Activity Part I (5 Minutes): Sketch Plan

1. Describe your overall domain*
2. List an enduring outcome for your course*
3. List a Learning Objective (LO) associated with that enduring outcome*
4. Create a constructive learning activity associated with that learning objective

*You may refer to previous assignments for this information.
Example

1. **Overall Domain:** Control Engineering for Chemical Engineers

2. **Enduring outcome:** Understanding the behavior of real processes as a consequence of their dynamic nature.

3. **LO:** Differentiate the building blocks of a complete process control loop and synthesize them to provide suitable process control solutions.

4. **Constructive activity:** Students will be given a conceptual model (printed diagram) of a process with two simple variables to control, namely temperature and level. They will be asked to predict the response of such variables to certain perturbations and select the perturbation with higher impact on the value of the variable.

Activity Part II (10 Minutes)
Discuss with your Group

Share your plan. Discuss connections between your questions/activities and your objectives.
Activity Part III
Lightning Talk Report Out

Share the key takeaways from your small group discussion on your constructive learning activity plans. Were there any similarities amongst group members?

From Constructive Learning to Interactive Learning

Gaining students’ attention and engaging them in constructive learning activities is more effective than when students are passive; however, it’s not the best we know how to do.

**Interactive learning** is most effective and can bring about the highest learning gains.

However, interactive learning is also the most time-intensive (for instructors and learners). Use it when you need it most (with the most important and difficult concepts).

So... look at your curricular priorities. Those that are the most important (enduring outcomes and important to know) are worth the “investment” in constructive and interactive activities.
Question: Your Experiences with Interactive Learning

What was your experience as an undergraduate student with interactive learning?
- First time you heard the term in a class setting or the first time you were asked to work with others in a class setting
- What did the instructor ask you to do?
- What rationale did the instructor provide?

Karl’s Experience

First Teaching Experience – Third-year course in metallurgical reactions – thermodynamics and kinetics
Karl’s Quandary

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

Lila M. Smith
Cooperative Learning: An Evidence-Based Practice for Interactive Learning

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 Introduced to Engineering – 1981


Undergraduate Teaching Faculty: The 2013–2014 HERI Faculty Survey

Figure 2. Changes in Faculty Teaching Practices, 1989 to 2014 (% Marking “All” or “Most” Courses)

Undergraduate Teaching Faculty, 2011*

<table>
<thead>
<tr>
<th>Methods Used in “All” or “Most”</th>
<th>STEM women</th>
<th>STEM men</th>
<th>All other women</th>
<th>All other men</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooperative learning</td>
<td>60%</td>
<td>41%</td>
<td>72%</td>
<td>53%</td>
</tr>
<tr>
<td>Group projects</td>
<td>36%</td>
<td>27%</td>
<td>38%</td>
<td>29%</td>
</tr>
<tr>
<td>Grading on a curve</td>
<td>17%</td>
<td>31%</td>
<td>10%</td>
<td>16%</td>
</tr>
<tr>
<td>Student inquiry</td>
<td>43%</td>
<td>33%</td>
<td>54%</td>
<td>47%</td>
</tr>
<tr>
<td>Extensive lecturing</td>
<td>50%</td>
<td>70%</td>
<td>29%</td>
<td>44%</td>
</tr>
</tbody>
</table>


Why Emphasize Cooperative Learning?

Student learning
- Essential **transferrable skill** development
- Key to **innovation**
- High priority for **Employers**
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

* [CL.ReturnstoCollege.pdf](CL.ReturnstoCollege.pdf)

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Discipline-Based Education Research (DBER) Report


Engaged Pedagogies = Reduced Failure Rates

Evidence-based research on learning indicates that when students are actively involved in their education they are more successful and less likely to fail. A new PNAS report by Freeman et al., shows a significant decrease of failure rate in active learning classroom compared to traditional lecture.

Freeman, Scott; Eddy, Sarah L; McDonough, Miles; Smith, Michelle K; Okoroafor, Nnadozie; Jordt, Hannah; Wenderoth, Mary Pat; Active learning increases student performance in science, engineering, and mathematics, 2014, Proc. Natl. Acad. Sci.

The College Degrees & Skills Employers Most Want in 2015 (National Association of Colleges & Employers (NACE))

The NACE survey also asked employers to rate the skills they most value in new hires. Companies want candidates who can think critically, solve problems, work in a team, maintain a professional demeanor and demonstrate a strong work ethic. Here is the ranking in order of importance:

<table>
<thead>
<tr>
<th>Competency</th>
<th>Essential Need Rating*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Critical Thinking/Problem Solving</td>
<td>4.7</td>
</tr>
<tr>
<td>Teamwork</td>
<td>4.6</td>
</tr>
<tr>
<td>Professionalism/Work Ethic</td>
<td>4.5</td>
</tr>
<tr>
<td>Oral/Written Communications</td>
<td>4.4</td>
</tr>
<tr>
<td>Information Technology Application</td>
<td>3.9</td>
</tr>
<tr>
<td>Leadership</td>
<td>3.9</td>
</tr>
<tr>
<td>Career Management</td>
<td>3.6</td>
</tr>
</tbody>
</table>

*Weighted average. Based on a 5-point scale where 1=Not essential, 2=Not very essential, 3=Somewhat essential, 4=Essential, 5=Absolutely essential

Observational study of over 2000 classes – most common behaviors:

- Faculty
  - Lecturing
  - Writing in real time
  - Posing nonrhetorical questions
  - Following-up on questions
  - Answering student questions
  - Clicker questions

- Students
  - Listening to instructor
  - Answering instructor questions
  - Asking questions

http://science.sciencemag.org/content/sci/359/6383/1468.full.pdf
Cooperation in the College Classroom

**Informal** Cooperative Learning Groups

**Formal** Cooperative Learning Groups

Cooperative **Base** Groups

Notes: Cooperative Learning Handout (CL-College-814.doc) [CL-College-814.doc]  

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Book Ends on a Class Session

Book Ends on a Class Session

1. **Advance Organizer**

2. **Formulate-Share-Listen-Create (Turn-to-partner) — 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?

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1. **Advance Organizer**

“The most important single factor influencing learning is what the learner already knows. Ascertain this and teach him accordingly.”

David Ausubel - Educational psychology: A cognitive approach, 1968.
2 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

2 Focus Question Examples

- Give an example
- Describe an application...
- Explain in your own words...
- Paraphrase the idea
- Support the following statement...
Activity: Developing a “Book Ends on a Class Session” Plan

Total Activity Time: ~20 minutes

Part 1: Individual Exercise (5 minutes)
Part 2: Small Group Discussion (15 minutes)
Part 3: Lightning Talk Report Out
Activity Part I (5 Minutes)

Sketch Plan

1. List Session Topic*
2. Learning Objective (for an Enduring Outcome)*
3. List Activity*
4. Write 2 – 4 “focus” questions.

*Use the same information here as you did for the first activity of today’s session.

Activity Part II (10 Minutes)

Discuss with your Group

Share your plan and focus questions with your group.
**Activity Part III - Lightning Talk Report Out**

Share the key takeaways from your small group discussion on your plans. Were there any similarities with plans or questions?

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**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 and one-time events (e.g., guest presentation)
- Include "book ends" procedure
- Are not as effective as Formal Cooperative Learning or Cooperative Base Groups
Active Learning: Cooperation in the College Classroom

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

Notes: Cooperative Learning Handout (CL-College-814.doc) [CL-College-814.doc]

Instructor’s Role in Formal Cooperative Learning

1. Specifying **Objectives** (Academic and Interpersonal/Teamwork)
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
Cooperative Problem-Based Learning Format

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

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

**INDIVIDUAL:** Develop ideas, Initial Model, Estimate, etc. Note strategy.

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

**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 model and strategies used 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.

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Decisions, Decisions...

- Group size?
- Group selection?
- Group member roles?
- How long to leave groups together?
- Arranging the room?
- Providing materials?
- Time allocation?
Optimal Group Size?

A. 2
B. 3
C. 4
D. 5
E. 6

Formal Cooperative Learning Task Groups

Group Selection?

A. Self selection  
B. Random selection  
C. Stratified random  
D. Instructor assign  
E. Other

Assigning Roles

Chapter 8: Group Roles and Responsibilities  
- Roles  
  - Facilitator  
  - Checker  
  - Set-Up  
  - Materials Manager  
  - Safety Officer  
  - Reporter  
  - Dividing the labor
Teamwork Skills

- Communication
  - Listening and Persuading
- Decision Making
- Conflict Management
- Leadership
- Trust and Loyalty

Chapters 3, 4, 5 & 6

TEAMWORK

Teaching Cooperative Skills

1. Help students see the **need** to learn the skill.
2. Help them **know how** to do it (T-chart).
3. Encourage them to **practice** the skill daily.
4. Help them **reflect on**, process, & refine use.
5. Help them **persevere** until skill is automatic

**Monitoring, Observing, Intervening, and Processing**

**Monitor** to promote academic & cooperative success

**Observe** for appropriate teamwork skills: praise their use and remind students to use them if necessary

**Intervene** if necessary to help groups solve academic or teamwork problems

**Process** so students continuously analyze how well they learned and cooperated in order to continue successful strategies and improve when needed
Team Charter

- Team name, membership, and roles
- Team mission
- Anticipated results (goal)
- Specific tactical objectives
- Ground rules/ Guiding principles for team participation
- Shared expectations/aspirations

pp. 60-61, 204-205

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**Group Ground Rules Contract Form**

(Adapted from a form developed by Dr. Deborah Allen, University of Delaware)

Project groups are an effective aid to learning, but to work best they require that all group members clearly understand their responsibilities to one another. These project group ground rules describe the general responsibilities of every member to the group. You can adopt additional ground rules if your group believes they are needed. Your signature on this contract form signifies your commitment to adhere to these rules and expectations.

All group members agree to:

1. Come to class and team meetings on time.
2. Come to class and team meetings with assignments and other necessary preparations done.

Additional ground rules:

1. 
2. 

If a member of the project team repeatedly fails to meet these ground rules, other members of the group are expected to take the following actions:

Step 1: (fill in this step with your group)

If not resolved:

Step 2: Bring the issue to the attention of the teaching team.
If not resolved:

Step 3: Meet as a group with the teaching team.

The teaching team reserves the right to make the final decisions to resolve difficulties that arise within the groups. Before this becomes necessary, the team should try to find a fair and equitable solution to the problem.

Member’s Signatures: 

Group Number:

1. ____________________ 3. ____________________
2. ____________________ 4. ____________________
The Instructor's Role in Cooperative Learning

Make Pre-Instructional Decisions
Specific Academic and Task Objectives:
- Group tasks that link (A) academic and (B) cooperative aspects and small group work with specific objectives.
- Select a Group Size: Leading groups should be small groups of three to four students.
- Decide on Group Configuration: Students should be in groups of four, each with a role.

Assign Roles: Each group member is responsible for a specific role: Lead, Reader, Recorder, or Checker.
- Arrange the Room: Group members should be seated in rows of four, each facing the teacher.
- Plan Materials: Assignments should be given to each group of four, as well as the materials needed to be used.
- Explain Task and Cooperative Structure: Explain the task, the objectives of the lesson, the cooperative structure, and specific exercises.
- Explain the Rules to Students: Ensure that students understand the cooperative structure and rules.
- Monitor and Evaluate: Regularly monitor and evaluate group progress.

Cooperative Lesson Planning Form

Subject Area: __________ Date: __________

Objectives:
- Academic:
- Social Skills:

Pre-Instructional Decisions:
Group Size: ________, Method of Grouping: Random
Roles:
- Group Arrangement:
  - One Copy Per Group
  - One Copy Per Person
  - Other

Explain Task and Cooperative Goal Structure:
1. Task:
2. Criteria for Success:
3. Points Incentives:
4. Individual Accountability:
5. Interdependence:
6. Expectations:

Monitoring and Intervening:
1. Observation Procedure: Formal, Informal
2. Observation By: Teacher, Students
3. Intervening For Task Assistance:
4. Intervening For Task Assistance:

Evaluating and Processing:
1. Assessment Of Members' Individually Learning:
2. Assessment Of Group Productivity:
3. Final Group Processing:
4. Whole Class Processing:
5. Charts And Graphs Used:
6. Positive Feedback In Each Group:
7. Goal Setting For Improvement:
8. Celebration:
9. Other:
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