HOW TO USE ACTIVE LEARNING EASILY
With special reference to STEM & other content heavy classes, even very large ones.
Increasing achievement and retention by applying key lessons from the scholarship of teaching and learning.

Craig E. Nelson
Emeritus Professor of Biology, Indiana University, Bloomington (at IUB since 1966)
Founding President, International Society for the Scholarship of Teaching and Learning
Outstanding Research and Doctoral Universities Professor Of The Year, 2000
Email: nelson1@indiana.edu (where 1 is the numeral one)

My teaching papers listed http://iub.academia.edu/CraigNelson/CurriculumVitae Especially pertinent today:

Diversity requires reformed pedagogy
[Ideas apply across the curriculum.]

An introduction to some key active learning techniques and why I used each of them.

Some ways we keep ourselves from adopting well-known best practices in teaching:

TODAY: In content heavy courses we often feel compelled to cover as much material as possible. In this workshop we will quickly examine some evidence this is a self-defeating strategy. We will then focus on more effective strategies that can be used in a class of any size, including in very large classes. These strategies rely on active learning exercises that have been carefully structured by the teacher to optimize learning. Participants will be asked to consider and discuss how these approaches might apply in their own teaching, perhaps as soon as Monday morning.

THIS HANDOUT IS A SET OF RESOURCES. WE WILL NOT DO IT ALL TODAY
OPENING EXERCISES

• Calculus—Highly Selective Institution—African Americans: 60% D, F & W.
  Survey of entire faculty—How can this be? How would colleagues explain? 3 Hypotheses

• Introductory Economics: 25% D & F. Why don’t more succeed? Your colleagues: 3 Hypotheses

• YOUR Department or Program. Faculty ideas: 3 or 4 main reasons more SS don’t succeed?

• PUT AN ASTERISK by the TWO most important reasons that more students don’t succeed.
APPLICATIONS CARD

DIRECTIONS: Please take a moment to recall the ideas, techniques, and strategies we've discussed – and those you've thought up – to this point in the workshop. Quickly list as many possible applications as you can. Don't censor yourself! These are merely possibilities. You can always evaluate the desirability and/or feasibility of these possible applications later. Return to this as often as you like during the session. (Source: Tom Angelo).

Interesting IDEAS/TECHNIQUES Some possible APPLICATIONS of those ideas/techniques to my work from this session
INTRODUCTION


As you watch, make notes on these points:

1. Gut reactions. Good or bad in what ways?

2. Contrast the approaches to learning used by “Susans” and by “Roberts.”
   What names are applied to these? Which is dominant in your students?

3. According to the clip, why is Robert’s approach reasonable? If so, who might change it? How?

GOOD LEARNING DESIGNS MOVE STUDENTS TOWARD DEEP LEARNING

• Approach used is NOT an intrinsic feature of the student but can vary from class to class.
• Good Learning Designs Increase Deep Learning
• Less Adequate Learning Designs Foster Surface Learning

Surface Approaches, “Roberts.” Concentrate only on assessment requirements--Get grade and get out.

• Accept ideas and information passively
• Memorize facts and procedures routinely
• No reflection on purpose or strategies in learning
• Associated with anxiety and fear of failure, and somewhat with vocational motives.
• Classes which students rated as having a heavy workload, or as having assessment procedures emphasizing the accurate reproduction of detailed information, are each likely to induce a surface approach to learning and studying.

Deep Approaches, “Susans.” Intention is to understand material for oneself

• Examine the logic of the argument
• Relate evidence to conclusions
• Relate ideas to previous knowledge/experience
• Interact vigorously and critically on content
• Linked with academic interest in the subject for its own sake and with self-confidence.
• The deep approach was more common in classes that have good teaching & freedom in learning.

SOURCES

• Noel Entwistle, nd. Phenomenography - http://web.cortland.edu/andersmd/learning/Phenomenography.htm

TWO (OR MORE) IMPORTANT TAKE HOME POINTS

• ANSWER: What would you say if asked about the importance of this video clip and these ideas?
• THEN: PUT ASTERISKS by the TWO points on this page (yours or mine) you want to discuss first.
THINGS CAN FIX WITH REVISED LEARNING DESIGNS
Some alternatives to blaming the students.

BIG DIFFERENCES BY FOSTERING DEEP PROCESSING OF CORE CONCEPTS

EXAMPLE: Economics Without Fs.


CONTEXT AND PROBLEMS: Introductory Economics.

REVISING THE LEARNING DESIGN
• Know: Students who do well (SOTL workshop): Understand conceptually & Process socially.
• Goal: Get most students to learn in the ways that the more academically successful do.
• Changes: Focused on deep understanding of core concepts (critical thinking)
  Used much more in-class discussion. Reduced content to allow processing.
• Controls: Multiple sections. Common mid-semester and final exams. So NO change in standards.

ASSESSING THE NEW LEARNING DESIGN (RESULTS):
• Results: New approach: Multiple semesters with No Fs & Few Ds. [Other sections increased]
• Faculty Resistance: Can’t be teaching! Must be students! [Lottery. Time slot. Grade inflation ……]

SIMILAR EXAMPLE: Calculus Without Fs.
• Changes: Deep Conceptual Learning:
  Write out in English how solved one homework problem each week & Most of class time in groups.
• Comparisons: Teacher’s own prior exams and success rate.
• Results: “for the first time in nearly 30 years of …calculus he did not fail single student”

IMPLICATIONS FROM BOTH EXAMPLES
• Coverage: How did reduced coverage affect learning in these two examples?
• Grade Inflation: The two new designs here produced large increases in average grades. Was this “grade inflation” good or bad?
• Perspectives: How do these results relate to your answers on the first page for econ? For MDC?
• Faculty Resistance: If you were among the faculty who doubted that these improvements were real,
  What more would it take to convince you to change?
• Other Implications?

• PUT ASTERISKS by the TWO points on this page you want to discuss first.
THINGS WE CAN FIX WITH REVISED LEARNING DESIGNS. Continued

Some alternatives to blaming the students.

MAKING BIG DIFFERENCES WITH VERY UNDERPREPARED STUDENTS

By Helping Students Understand How To Do What Teachers Really Want

CONTEXT: Daley College, Chicago City (Community) College System.


Face the stresses of freshman year with “little support.”

APPLY: What Proportion Of YOUR STUDENTS Match Most Or All Of These Features?

REVISING THE LEARNING DESIGN

• Discover what more successful students are doing (from SOTL literature and informal observation).

  Successful students usually have a significant social support system

  Successful students know what teacher wants and can integrate skills (“well-prepared”)

• Design Goal: Get most students to learn in the ways that the more academically successful do.

REVISED LEARNING DESIGN: Structured Supplemental Instruction

• Intervention group: From students who were taking two or more remedial courses

• Social support: Groups of 7-10, 8 meetings in the semester, Part-time staff as "tutor-facilitator"

• Required participation: • 15% of grade determined by participation (replaced participation)

  No other changes in standards: Same faculty delivered courses and graded as usual.

  Required extra homework: Integrated math, English, and reading comprehension

    Exercises & discussion questions over specially designed, multi-chapter science fiction story.

    • “Suppose you wanted to use an Anikan spy shuttle to return to Earth. You know that one light year is equivalent to six trillion miles. You also discover that the shuttle can travel one-fourth light year per Earth week,” begins one question. “How long would it take you and your team to reach Earth in the shuttle, if the team is located two and one-half light years from earth?”

    • Another question asks students to debate the merits of using the spy shuttle to return to Earth, assuming that the ship’s life support and supplies can sustain the crew for only five weeks.

    • Another asks students to pick a sentence from the reading and identify its subject, verb, and predicate.

ASSESS NEW LEARNING DESIGN (RESULTS):

• 80-90% passed their remedial courses v about 40% of those who were not in this program.

SOURCES

• Chicago CC doubles remedial pass rates
  http://communitycollegespotlight.org/content/chicago-cc-doubles-remedial-pass-rates_5585/

• Remedial Plus. Derek Quizon. Inside Higher Education. 9/9/2011.


GENERALIZABILITY


• Many similar projects: Google: Supplemental Instruction and your field.

APPLY: How could you build such support into your program or into your own courses?

& What would you say if asked about the importance of this example? [Applications card?]
THINGS CAN FIX WITH REVISED LEARNING DESIGNS. Continued

MAKING BIG DIFFERENCES WITH ALL GROUPS OF STUDENTS
And simultaneously leveling the playing field for students with heterogeneous backgrounds
By Helping Students Understand How To Do What Teachers Really Want

CONTEXTS: IU Southeast (Pretty open). IU Bloomington (Selective). Harvard (Very Selective)

PROBLEMS: Many students do poorly on basic academic tasks:
Comprehending lectures, Reading, Multiple-choice exams, Essay exams, Writing ....

APPLY: Which basic academic tasks give YOUR OWN STUDENTS the most trouble?

BASIC ISSUES
• Issue 1: Many students don’t understand how to do core academic tasks.
  Even at Harvard: Students who were in academic difficulty were working harder …
• Issue 2: Expectations vary widely across courses (and faculty don’t know it).

ADDRESSING THE ISSUES: REVISIGN THE LEARNING DESIGNS
• Discover what more successful students are doing (From SOTL literature and informal observation).
• Design Goal: Get most students to learn in the ways that the more academically successful do.
• Interventions: TEACH how to do core academic tasks. Teach, NOT just explain.
  = Get most or all students to do what successful (privileged) students learned to do earlier.
  Key: Have students practice doing key outcomes BEFORE assessment affects grade

EXAMPLE: Comprehend Lectures & Master Multiple-Choice Questions. Introductory Biology


EXAMPLE: Deep Understanding of Readings & Synthesis. Intensive Freshman Seminar:
Problem: Never learned to read and accurately summarize an argument. [v “What it is about.”]
Fix: First day. In-class, open book, Exam-Ready Essay question. Pairs and then groups …

EXAMPLE: Readings: Increase effort and Deep Understanding of Readings:
“Highlight” Readings Using Exam-Ready Questions As Study Guides
Give all or large fraction of the question pool
Intro Psychology: 1600 m.c. questions. My courses: 20-25 essay questions per chapter.
Flips content: Use of class time for processing (concepts, graphs, equations, applications…)
Makes out-of-class group work possible and effective (v guess what prof is thinking).
Makes review sessions more productive. How far did you get?
Better than using lectures to highlight readings for many (most?) topics

APPLY: Three Academic Skills That Are Essential For Success In Your Course?
For each, how do you or could you actively teach the students how to do it? NOT just tell them!
How could you have students practice doing key outcomes BEFORE assessment affects grade?
THINGS WE CAN FIX WITH REVISED LEARNING DESIGNS. Continued
Some alternatives to blaming the students.

MAKING BIG DIFFERENCES BY TAKING CONTROL OF SOCIAL SYSTEM
And simultaneously leveling the playing field for students with heterogeneous backgrounds

CONTEXT AND PROBLEMS: Treisman’s study.

FACULTY VIEWS: Informal Survey, Broken Students.
Grant. Faculty hypotheses Failed! Math scores + Forced to desperate measures: __________

FIGURING OUT THE PROBLEM: Qualitative & Narrative explorations of problem
• Goal: Find out what successful students are doing and, thus, what other students need to do.
• Treisman tracked how different groups of students studied calculus.
• Students who were doing well had great out-of-class social support:
  Spontaneous study groups, older peers helped, old homework and exams by social inheritance
• Students who were not doing well mostly worked in isolation
  Core Issues: Elite v Non-College Prep. High School Programs => Few Serious Peers;
  Achievement Low Social Value; Penalize Peer-Checking; Don’t Study Together Effectively

ADDRESSING THE PROBLEM: REVISE THE LEARNING DESIGN
• Goal: Get most students to learn in the ways that the more academically successful do.
• Treisman’s Design Hypothesis: Calculus class as a social system. Take control of it!
  Honors homework sections (v “Diss”); Softball games between sections ….
  Required peer checking (or etc.); Classic exam problems etc. in homework sections

ASSESS THE EXTENT TO WHICH REVISED LEARNING DESIGN WORKS
• Same large lecture sections and same exams as all students. No change in standards.
• D, F & W from 60% to 4%. AND: Higher grades in subsequent math and science courses.

SOURCES

GENERALIZABILITY
• Other Merit Programs Based on the Treisman Model. http://merit.illinois.edu/educators_treismanprograms.html

IMPLICATIONS
• Apply: How could you take control of your class as a social system to broaden engagement?
  • Evaluate: What would you say if asked about the importance of this example? [Applications card?]
  • Perspectives: How do these results relate to your answers on the first page for calculus? For MDC?
• PUT ASTERISKS by the TWO points on this page you want to discuss first.
THINGS CAN FIX WITH REVISED LEARNING DESIGNS. Continued

Some alternatives to blaming the students.

FINAL EXAMPLE: More Support For Switch To Addressing Learning Designs

• Physics: Structured active learning v traditional lecture: Standardized pre and post tests. Doubles average conceptual gain. Best triples = 4 Standard Deviations better than traditional.


Active-learning increased conceptual mastery in introductory physics to 90% of students v 15% after lecture  NOTE

P. S. Student Services Can Really Help

• Scott Jaschik. 2014. An Hour Makes a Difference. [“A one-hour [‘next-to-no-cost’] program for new students” “can close 63 percent of the achievement gap (measured by such factors as grades) between first-generation and other students.” “… college juniors and seniors from a range of backgrounds talk about how they adjusted to college, and how they sought out resources and people to help them with decisions, issues they didn't understand and so forth. First-generation students talked about their specific challenges.” “To avoid stigmatizing the first-generation students, the programs were described as being for all students, with a range of backgrounds, and the panelists speaking were from a range of backgrounds.” http://www.insidehighered.com/news/2014/02/17/study-1-hour-program-can-close-achievement-gap-first-generation-college-students

IMPLEMENTING ACTIVE LEARNING IN YOUR CLASSES—FOUR BASICS

1. PREPARATION: NEED ESSENTIALLY ALL STUDENTS PREPARED.
   Make it Count ENOUGH in grade to get (almost) all to prepare
   General Knowledge, In-Class Reading or Lecture, Worksheet or Paragraph, Quiz…
   Example: RED-PEN WORKSHEETS

2. SOCIAL SYSTEM (Groups & Roles). Every Student Participating Constructively [v Equally]
   [S-S Discussion; NOT T-S OR S-T “Recitation”]
   Write-Pair-Share For Short Times. Two-Minutes & Social Roles …
   Teacher Formed Groups of 5-6 for Longer Discussions
   Group Responsible For All Participating or All Loose Points

3. BACKWARDS COURSE DESIGN.
   • Begin with a focus on key higher-level outcomes (academic skills):
     How assess the outcomes? How provide practice assessments? What content will best foster this?
     Backwards compared with starting with content outline and trying to shoehorn in outcomes.
     This Will: Get most students to learn in the ways that the more academically successful do.
     And will usually raise all students to higher levels of achievement.

4. EVALUATION: KEEP IT QUICK AND SIMPLE SO YOU WILL USE IT
   • Practice Assessments: In class peer-comparisons with whole group processing (MC Questions, above)
   • Practice Assessments: Worksheets. Quizzes:
     RED PENS (again) Credit for serious effort [NO need to discuss if you expect most to have correct.]

APPLY: How might you apply some of these ideas more deeply in one of your classes?
FUNDAMENTALS OF “MISCONCEPTIONS”

Example: Physics.
• Grounded in Direct Personal Experience. Example: Proximity and warmer (cooler).
• Well-Grounded Idea Fails in New Context: Seasons.
• Very Difficult To Get Switch: Deeply grounded personal experience trumps academic arguments.
  Physics: “impossible” to change with straight lecture. Requires structured active learning. Mazur.
  
  :  Structured Classroom Demonstrations Straight demos have no effect.
  
  Add prediction with discussion, do demo, then more answers and interactions.


Example: Preparation, Motivation, Effort & Learning
• Direct Experience. Your life? Your students in one course?
• Well-Grounded Idea Fails New Context: Across learning designs.
  • Very difficult to switch: Deeply grounded personal experience trumps academic arguments
• TODAY: Predictions with discussion (pg 1). Examples. Then more answers and interactions.

ATTEMPTING THE POSSIBLY IMPOSSIBLE WITH YOU:
Reframing how we think about college teaching

EVIDENCE-BASED THINKING AS KEY LEARNING PROBLEM FOR SOCIETY
• Evidence-Based Medicine. New! Really??
• Evidence-Based College Teaching. New! Really??

PARADOX OF COVERAGE.
• SEEMS like should teach more if cover more. BUT, this is a dysfunctional illusion of rigor.
• Learning designs that reduce coverage and add focused active learning always teach more.
• Traditional coverage often forces teachers to oversimplify and to leave out connections, etc.
• Traditional coverage can switch students to bulimic or surface learning, minimizing retention.
• Traditional coverage rewards low level, memorization, and inhibits the development of higher-order critical thinking and communication.

BACKWARDS COURSE DESIGN. Needed as so few of our students reach higher-level goals.
• Begin with a focus on key higher-level outcomes (academic skills):
  How assess the outcomes? How provide practice assessments? What content will best foster this?
  Backwards compared with starting with content outline and trying to shoehorn in outcomes.
  This Will: Get most students to learn in the ways that the more academically successful do.
  And will usually raise all students to higher levels of achievement.

GESTALT SWITCH: FROM Good v bad students TO More or less effective learning designs.
• Good teaching is getting other students to do what the more successful students are doing.

SUMMATIVE: Are you ready to try to quit blaming the students and to try new learning designs?
Why or why not?
A FEW GREAT SOURCES FOR INTERACTIVE ENGAGEMENT & ACTIVE LEARNING

BOOKS (Great Sources for Proven Techniques):


Case Study Teaching in Science, National Center for. SUNY-Buffalo (Clyde Herreid) [How to and many cases.] http://ublib.buffalo.edu/libraries/projects/cases/case.html Don’t miss the links to other case studies sites: http://ublib.buffalo.edu/libraries/projects/cases/webcase.htm MERLOT ELIXR 70+ discipline-specific multimedia cases/stories for faculty. http://elixir.merlot.org/case-stories

• Clicker Videos (Why and how to use in intro and advanced classes) http://STEMvideos.colorado.edu

Just-in-Time-Teaching. “JiTT is a teaching and learning strategy based on the interaction between web-based study assignments and an active learner classroom. Students respond electronically to carefully constructed web-based assignments which are due shortly before class, and the instructor reads the student submissions "just-in-time" to adjust the classroom lesson to suit the students' needs…. we are aware of approximately 300 faculty in 25 disciplines at approximately 100 institutions … who have adopted the JiTT strategy.” http://webphysics.iupui.edu/jitt/jitt.html

Mazur’s Peer Instruction [Brief lecture segments interspersed with carefully structured discussion.]

Process Oriented Guided Inquiry Learning (POGIL). “A POGIL classroom or lab consists of any number of students working in small groups on specially designed guided inquiry materials. ….The instructor serves as facilitator, observing and periodically addressing individual and classroom-wide needs. POGIL is based on research indicating that a) teaching by telling does not work for most students, b) students who are part of an interactive community are more likely to be successful, and c) knowledge is personal; students enjoy themselves more and develop greater ownership over the material when they are given an opportunity to construct their own understanding.” http://www.pogil.org/info/introduction.php

Problem-based Learning, especially in large classes. http://chemeng.mcmaster.ca/plb/plb.htm Problem Based Learning

Clearing House. University of Delaware. https://chico.nss.udel.edu/Pbl/ See also list of sites: http://www.udel.edu/plb/others.html

SCALE-UP = Student-Centered Active Learning Environment for Undergraduate Programs. http://scaleup.ncsu.edu Was “Student-Centered Activities for Large Enrollment Undergraduate Physics.” Now used more widely. Classes of 100 or more (or fewer), “most of the "lectures" are actually class-wide discussions.” Three teams per round table…

SOME IMPORTANT BASIC RESOURCES [TAKE-HOME]

AIM HIGH: Focus on Major Outcomes


“BACKWARDS DESIGN.” Use one of these in Designing or Revising a Course:


IS IT WORKING? ASSESS AND DOCUMENT WHAT IS HAPPENING IN YOUR CLASS

Treat ALL assessments as measures of the success of the learning design.

Use Some “CATs:” Check on how any course is actually working:


Course Portfolios.

• Daniel Bernstein et al. 2006. Making Teaching and Learning Visible: Course Portfolios and the Peer Review. Anker.

LOOK BROADLY Two Major Collections of Teaching Resources:


GREAT FIRST DOWNLOADS: Each offers free summaries of research on key topics

• IDEA Papers. Topics include Improving Lectures, Improving Discussions, Improving Essay Tests, Improving Student Writing, Improving Grading, Evaluating Teaching and many more. 4-8 pages each, feature both techniques and introduction to literature. Free PDFs http://www.theideacenter.org/category/helpful-resources/knowledge-base/idea-papers
• POD-IDEA Center, Notes on Instructional Improvement. Free PDFs. http://www.theideacenter.org/node/64

BOOKS TO USE WITH STUDENTS. Faculty and student advisors should read, too (All on Amazon)

• Integrations: Reading, Thinking, and Writing for College Success. William S. Robinson & Pam Altman (2002)
• Learning to Communicate in Science and Engineering: Case Studies from MIT. Mya Poe, Neal Lerner, & Jennifer Craig (2010) *
• Thinking Ahead for College Success: A First Year Student's Guide. Thomas B. Jones (2011) *