MAXIMIZING LEARNING WHILE INCREASING, RETENTION AND EQUITY:
Key Pedagogical Changes that Can Make a Real Difference In ANY College Classroom Without Lowering Standards.

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

Diversity requires reformed pedagogy
• Nelson, C. E. 1996. Student Diversity Requires Different Approaches to College Teaching, Even in Math and Science. *American Behavioral Scientist.* 40(2):165-175. http://mypage.iu.edu/~nelson1/96_StudentDiversity.pdf
[Ideas apply across the curriculum.]

An introduction to some key active learning techniques and why I used each of them.
• Nelson, C. E. 2010. Want brighter, harder working students? Change pedagogies! Some examples, mainly from biology. In Barbara Millis, Editor. *Cooperative Learning in Higher Education: Across the Disciplines, Across the Academy.* Chapter 8. Pp. 119-140. Stylus. http://mypage.iu.edu/~nelson1/10_Want Brighter Harder Working Proof.pdf

• Nelson, C. E. 2009. The "Red Pen" Worksheet. *Quick Start Series*. Center for Excellence in Learning & Teaching. Humboldt State University. 2 pp. http://mypage.iu.edu/~nelson1/09_Red Pen Worksheets.pdf

Some ways we keep ourselves from adopting well-known best practices in teaching*:*
• Nelson, C. E. 2009 (2010). Dysfunctional illusions of rigor: Lessons from the scholarship of teaching and learning. In Linda B. Nilson & Judith E. Miller, Editors. *To Improve the Academy: Resources for Faculty, Instructional, and Organizational Development.* 28:177-192. Jossey-Bass. http://mypage.iu.edu/~nelson1/09_Dysfunctional Illusions.pdf

TODAY: Many faculty members quite mistakenly assume that addressing retention and equity must mean lowering the standards for learning. Actually, however, we now know that the most effective ways to increase learning also increase retention and equity. When I began teaching, I prepared good, lectures and assumed that if some students didn't learn the material then there must be something wrong with those students (not-really studying much, distracted by work and family commitments, partying too much, under-prepared, etc.). Later, I was introduced to key research findings showing that (and why) standard university teaching is often ineffective even when the students are working reasonably hard. Moreover, key alternative approaches can lead to large increases in student success and in equity across the entire curriculum (increasing remedial pass rates from 40% to 90%; calculus and economics with no Fs; double or even triple learning success in physics; etc.).

In this workshop, we will examine some key changes that can make real differences in learning and also in retention and equity in any college classroom without lowering the standards for achievement. Specific topics will include: 1. How can I radically reduce or largely eliminate low grades in lecture courses without lowering standards? 2. How can I make my students markedly brighter and harder working using only 1 hour of class time (in ways that level the playing field for all groups)? 3. How else can I modify my assignments to maximize achievement? Serendipitously, using these new approaches to maximizing learning will also markedly increase success rates for non-traditional students (first-generation, rural, inner-city, minority, etc.)? We will need to distinguish between keeping or even raising standards for achievement and certain *dysfunctional illusions of rigor* that often get in the way of effective teaching. In sum: How do many traditional teaching techniques unnecessarily limit the learning both of many traditional students and of many non-traditional students?

Mini-lectures will alternate with writing and small- and whole-group discussions of examples and implementation. 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 Program:** ***Faculty ideas of 3 or 4 main reasons more students don't succeed?***

• **PUT AN ASTERISK by the TWO most important reasons that more students don't succeed.**

INTRODUCTION

VIDEO CLIP: ***Teaching Teaching & Understanding Understanding.*** Part 1.

• *Video on Bigg's ideas:* Claus Brabrand. 2006. ***Teaching Teaching & Understanding Understanding***. Aarhus University Press. http://video.google.com/videoplay?docid=-5629273206953884671 [view]; http://www.unipress.dk/en-gb/Item.aspx?sku=1304 [Detailed summary] http://www.daimi.au.dk/~brabrand/short-film/ [On-line viewing (and buying) options]

• Biggs, John & Catherine Tang. 2007. ***Teaching for Quality Learning at University*** 3rd Edit. Open University Press. (Society for Research Into Higher Education, UK). See: http://www.johnbiggs.com.au/academic.html

→ ***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

Surface Approaches, "Roberts." Concentrate only on assessment requirements--***Get grade and get out***.
- Accept ideas and information passively
- Intent is simply to reproduce parts of the content
- Memorize facts and procedures routinely
- Fail to recognize guiding principles or patterns
- No reflection on purpose or strategies in learning
- ***Associated with anxiety and fear of failure, and somewhat with vocational motives.***

Deep Approaches, "Susans." Intention is to understand material for ones self.
- 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.***

• **Approach used is *NOT an intrinsic feature of the student* but *can vary from class to class.***

• *Good Learning Designs Increase Deep Learning.*
The deep approach was more common in classes that have good teaching & freedom in learning.

• *Less Adequate Learning Designs Foster Surface Learning.*
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.

SOURCES
• Biggs, John & Catherine Tang. 2007. *Teaching for Quality Learning at University* 3rd Edit. Open University Press. (Society for Research Into Higher Education, UK). & Video: *Teaching_teaching, Understanding_understanding.*
• Noel Entwistle**.** nd. *Phenomenography* **-** http://web.cortland.edu/andersmd/learning/Phenomenography.htm
• Rhem, James. 1995. Deep/Surface Approaches to Learning: An Introduction. *The National Teaching and Learning Forum* 5, no. 1: 1-5. http://www.ntlf.com/html/pi/9512/article1.htm
• Rhem, James. 2009. Deep/Surface Approaches To Learning In Higher Education: A Research Update. Essays on Teaching Excellence. 21(8) http://www.podnetwork.org/publications/essayseries.htm#2009-2010%20Essay%20Series

→ **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: *Do Applications Card (next page)*

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 from this session	***Some possible APPLICATIONS*** of those ideas/techniques to my work

THINGS WE CAN FIX WITH REVISED LEARNING DESIGNS

Some alternatives to blaming the students or the faculty.

BIG DIFFERENCES BY FOSTERING DEEP PROCESSING OF CORE CONCEPTS

EXAMPLE: Economics *Without Fs.*

• Nelson, C. E. 1996. Student Diversity Requires Different Approaches to College Teaching, Even in Math and Science. *American Behavioral Scientist* 40:165-175. http://mypage.iu.edu/~nelson1/96_StudentDiversity.pdf

CONTEXT AND PROBLEMS: Introductory Economics.
• Multiple sections. Common mid-term and final. Fixed curve: 25% D & F. [Why 25%? Given]

REVISING THE LEARNING DESIGN
• **Know:** ***Students who do well*** *(from SOTL)**:*** 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. …..]

SIMILAR EXAMPLE: Calculus *Without Fs.*

• Angelo, T. A. and K. P. Cross. 1993. Example 4. pp. 69-72 in *Classroom Assessment Techniques*. 2nd edit. Jossey Bass.

• **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:** *Increased use of discussion limits how much content can be covered in class.*
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 SCC?***

• **Faculty Resistance:** *If you were among the faculty who doubted that these improvements were real,*
what more would it take to convince you: That the results were real?
That similar change was possible here?

• **Other Implications?**

• ***PUT ASTERISKS*** *by the TWO points on this page that you want to discuss first.*

THINGS WE CAN FIX WITH REVISED LEARNING DESIGNS, Continued

Some alternatives to blaming the students or the faculty.

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.
Population: ***1st generation***. From ***low-income*** families. Very "***ill-prepared academically***."
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.
  http://www.insidehighered.com/news/2011/07/15/daley_college_sees_success_with_new_remedial_program
- **Self-study Report.** *daley.ccc.edu/pdfs/DaleyCollege-SelfStudy-Report2011.pdf*

GENERALIZABILITY

- International Center for Supplemental Instruction. http://www.umkc.edu/asm/si/index.shtml
- Many similar projects: Google: *Supplemental Instruction and your field.*

→ **APPLY:** ***How could you build such support into your program or into your own courses?***
AND: *What would you say if asked about the importance of this example?* [Applications card?]

THINGS WE 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: I U Southeast (Pretty open). **I U 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 3 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: REVISING 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*
• Nelson, C. E. 2010. Want brighter, harder working students? Change pedagogies! Some examples, mainly from biology. In Barbara Millis, Editor. *Cooperative Learning in Higher Education: Across the Disciplines, Across the Academy*. Chapter 8. Pp. 119-140. Sterling, VA: Stylus Press. **INCLUDES SEVERAL OTHER EXAMPLES**

EXAMPLE: Essay Questions. Introductory writing. How to construct an A answer. *Mitzi Streepey.*
• Nelson, C. E. 1996. Student diversity requires different approaches to college teaching, even in math and science. *American Behavioral Scientist* 40:165-175. http://mypage.iu.edu/~nelson1/96_StudentDiversity.pdf
[Ideas apply across the curriculum.]

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?

IMPLEMENTING FOCUSED 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: <u>RED-PEN WORKSHEETS, Red-Pen Quizzes, Graded on showing effort.</u>

→ ***How do you (or could you) get nearly all students to prepare for active learning in class?***

2. SOCIAL SYSTEM (Groups & Roles). Every Student Participating Usefully [v Equally]

[*S-S Discussion; NOT T-S OR S-T "Recitation"*]

Write-Pair-Share For Short Times. ***Two-Minute Warning & Social Roles …***

Teacher Formed Groups *of 5-6* for Longer Discussions

Group responsible for all participating or all loose points

→ ***How do you (or could you) get nearly all students to participate usefully?***

3. OUTCOMES FOCUSED. IDEALLY, BACKWARDS COURSE DESIGN.

- ***KEY: MAKE SURE YOU FOCUS STUDENTS ON IMPORTANT OUTCOMES.***
- ***GREATEST POWER: 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.

→ ***Where in your course do you (or could you) start with outcome (not content), select summative assessment, and then design exercises that lead to success on that assessment?***

→ ***How is this related to the Three Essential Academic Skills exercise we did earlier?***

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.]*

- Papers: John Bean. 1996. *Engaging Ideas: The professor's Guide to Integrating Writing, Critical Thinking, and Active learning in the Classroom.* Jossey-Bass.

→ ***How do you (could you) give assignments that you grade on effort rather than details?***

5. TWO ADDITIONAL POINTS

- **Fundamental:** ***Get Prompt Feedback From Students and MODIFY Class As You Go***

Examples: MC Question & Show hands or Cards. Share after write-pair. Debrief after red-pen quizzes.

- **Fundamental:** ***Get Quicker Student Acceptance—Avoid First-Use Drop in Evaluations***
  - Avoid Re-Inventing Square Wheels: *Start with established methods* (see next page) and *deviate only with caution.*
  - *Explain WHY* you are teaching in atypical ways (increase learning and grades, etc.)
  - *Lower Perceived Risk to Grades:* Promise initially to make grades at least as good as before
    Then: Point out that grades are indeed better *without any correction* (they almost always are)
  - *Offer option:* If you don't want to do the discussions, see me and we'll figure out an alternative project or paper.
  - **"Mid"-Semester Reactions & Re-Explanations**

→ ***PUT ASTERISKS BY 2 OF YOUR POINTS THAT YOU MAY WANT TO SHARE IN SMALL GROUPS***

A FEW GREAT SOURCES FOR INTERACTIVE ENGAGEMENT & ACTIVE LEARNING *[Who has used?]*

BOOKS *(Great Sources for Proven Techniques):*

• John Bean. 2011. *Engaging Ideas: The Professor's Guide to Integrating Writing, Critical Thinking, and Active Learning in the Classroom.* Jossey-Bass; 2 edition. EXTREMELY USEFUL STEP BY STEP GUIDE
• B. Millis. (Ed). 2010. *Cooperative Learning in Higher Education: Across the Disciplines, Across the Academy.* Stylus.
• Elizabeth F. Barkley. 2009. *Student Engagement Techniques: A Handbook for College Faculty.* Jossey-Bass.
• Elizabeth Barkley et al. 2004. *Collaborative Learning Techniques: A Handbook for College Faculty.* Jossey-Bass.
• Barbara J. Millis & Philip G. Cottell. 1997. *Cooperative Learning For Higher Education Faculty*. Oryx Press.

REVIEW ARTICLES: • Smith, Karl A, Sherri D Sheppard, David W Johnson, Roger T Johnson 2005. Pedagogies of Engagement: Classroom-Based Practices. *Journal of Engineering Education*. 2005:87-101.
• Johnson, D., R., Johnson, & K. Smith. 1998. "Cooperative Learning Returns to College: What Evidence is There That it Works?," *Change*, Vol. 30, No. 4. July/Aug., 1998, p. 26–35. ***[168 Studies]***.
• Springer, L., M. Stanne, & S. Donovan. 1999. Effects of Small- Group Learning on Undergraduates in Science, Mathematics, Engineering and Technology: A Meta-Analysis. *Review of Educational Research*, 69(1) 21–52. ***[37 STEM Studies. Average effect "would move a student from the 50th percentile to the 70th" on a normalized distribution***

Overview: 50 Different Active Learning Pedagogies: Teaching Methods. Science Education Resource Center (SERC). http://serc.carleton.edu/sp/library/pedagogies.html

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://elixr.merlot.org/case-stories

Classroom [Personal] Response Systems ("Clickers"): • *Instructor's Guide to Effective Use of Personal Response Systems*. http://www.cwsei.ubc.ca/resources/files/Clicker_guide_CWSEI_CU-SEI.pdf • Derek Bruff. *Classroom Response System ("Clickers"), Bibliography***.** [***Science, Communications, Engineering, Education, English, Law, Nursing, Political Science and more***] www.vanderbilt.edu/cft/resources/teaching_resources/technology/crs_biblio.htm
• Derek Bruff. *Teaching with Classroom Response Systems* [Blog]. http://derekbruff.com/teachingwithcrs/?page_id=2
• *Resources on Personal Response Systems ("Clickers") http://www.cwsei.ubc.ca/resources/clickers.htm*
• *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
• Scott Simkins & Mark Maier. 2009. *Just in Time Teaching: Across the Disciplines, and Across the Academy*. Stylus.

Mazur's Peer Instruction [Brief lecture segments interspersed with carefully structured discussion.]
• Mazur, E.. Harvard. Physics. Education Research Page. Peer Instruction [=PI] and related topics. http://mazur-www.harvard.edu/education/educationmenu.php *Includes videos as well as article downloads*
• Crouch, Catherine H. and E**. Mazur**. 2001. Peer Instruction: Ten Years of Experience and Results *Am. J.Phys.*, 69, 970-977. At: http://mazur-www.harvard.edu/education/educationmenu.php

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/pbl/pbl.htm **Problem Based Learning Clearing House**. University of Delaware. https://chico.nss.udel.edu/Pbl/ See also list of sites: http://www.udel.edu/pbl/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…

Team Based Learning. http://www.teambasedlearning.org/ See Also: Michaelsen, L. K., A. B. Knight and L. D. Fink. Eds. 2004. *Team-Based Learning: A Transformative Use of Small Groups in College Teaching.* Stylus. ***Video***: http://www.utexas.edu/academic/ctl/largeclasses/#tbl & Search http://www.youtube.com/

THINGS WE CAN FIX WITH REVISED LEARNING DESIGNS. Continued

Some alternatives to blaming the students or the faculty.

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.

University of California, Berkeley. Calculus: 60% D, F & W rate for African Americans. ***Visible.***

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: (My HS) 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!
    Required **peer checking** (or etc.); ***Classic exam problems*** **etc. in homework sections**
    Also: Honors homework sections (v "Diss"); Softball games between 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

- Treisman, [P.] U. 1992. Studying Students Studying Calculus: A Look at the Lives of Minority Mathematics Students in College. *College Mathematics Journal* 23: 362-372. http://math.sfsu.edu/hsu/workshops/treisman.html
- Fullilove, R. E. & P. U. Treisman. 1990. Mathematics Achievement Among African American Undergraduates at the University of California, Berkeley: An Evaluation of the Mathematics Workshop Program. *Journal of Negro Education* 59: 463-478.

GENERALIZABILITY

- Mark Filowitz, Sean Walker, Martin V. Bonsangue, Hye Sun Moon, and Edward Sullivan. 2012. Supplemental Instruction for Increased STEM Student Success. *League for innovation in the Community College, Learning Abstracts.* April 2012, Volume 15, Number 4. http://www.league.org/blog/post.cfm/supplemental-instruction-for-increased-stem-student-success
- 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* ***SCC?***

- ***PUT ASTERISKS*** *by the TWO points on this page you want to discuss first.*

HOW FAR CAN WE IMPROVE LEARNING DESIGNS?

EXAMPLE: COMPARISONS ACROSS PEDAGOGIES, INTRODUCTORY PHYSICS.

- **Physics:** 50+ Years research; 12+ PhD Physics Educ. Research Programs; 70+ Research Groups
- **Two key barriers, focus of active learning:** ***Misconceptions & Concrete (v Formal) Reasoning.***
  Trying to fix these with lectures, readings etc. ***"Futile."*** *Requires active cognitive change.*
- **Developed Effective Assessments:**
  Multiple-choice ***concept inventories*** with misconceptions as alternatives, used as pre and post-tests
  Concrete (v Formal) Reasoning tests
  - Lawson, A. E., 2000. *Classroom Test Of Scientific Reasoning, Revised Version.* Available at: http://www.public.asu.edu/~anton1/LawsonAssessments.htm
  - *Test of Logical Thinking.* Available at: http://www.as.wvu.edu/phys/rotter/phys201/1_Habits_of_the_Mind/Test_of_Logic_Thinking.html
- **Developed Effective New Pedagogies**
  - Hake, R. R. 1998b. *Interactive-engagement methods in introductory mechanics courses.* Online at http://www.physics.indiana.edu/~sdi/IEM-2b.pdf [Note the focus on comparing alternative pedagogies.]
  - Crouch, Catherine H. and E**.** Mazur. 2001. Peer Instruction: Ten Years of Experience and Results. *American J. Physics.*, 69, 970-977. At: http://mazur-www.harvard.edu/education/educationmenu.php
  - Thornton , R. K, (1999). *Using the results of research in science education to improve science learning.* Keynote, International Conference on Science Education. http://probesite.concord.org/what/articles/thornton.htm
    [Active-learning increased **conceptual mastery** in introductory physics to **90% of students v 15% after lecture]**
  - Mazur, E. 2009. **Farewell, Lecture?** *Science, 323,* 50-51.

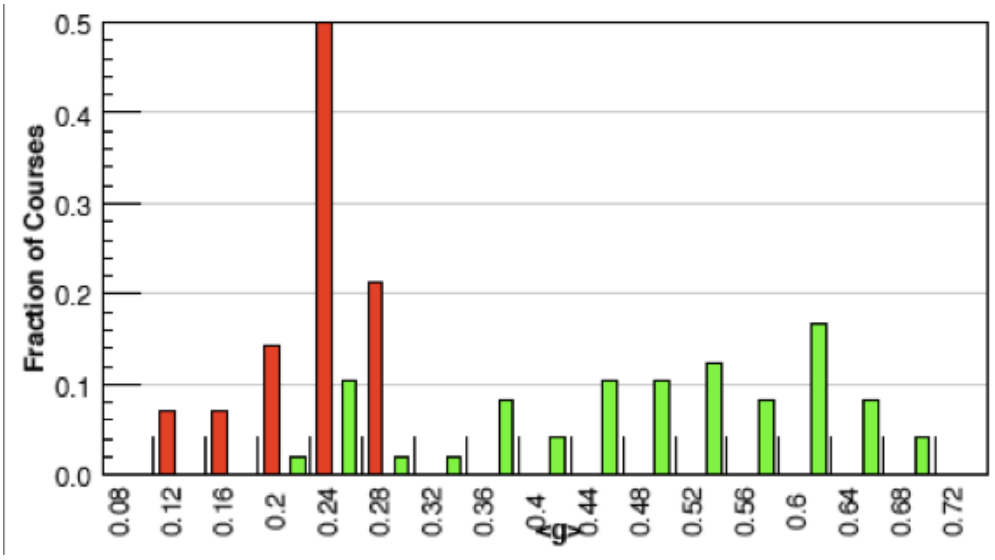
Meta-analysis

- Hake, R. R. 1998a. Interactive-engagement vs traditional methods: A six-thousand-student survey of mechanics test data for introductory physics courses. *American Journal of Physics* 66:64-74. http://www.physics.indiana.edu/~sdi/ajpv3i.pdf
- Hake, R. R. 2002. Lessons From the Physics-Education-Reform Effort. *Ecology and Society* 5(2):28 [online] http://www.ecologyandsociety.org/vol5/iss2/art28/

New Index for Comparing Pedagogies

- **Individual's** % ***normalized learning gains*** = 100 x (posttest score - pretest score)/(100- pretest score).

This asks how much improvement that student made from pre to post-test *as a fraction of the maximum improvement possible.* Gain of 50% is half of the difference between 100 and that student's pre-test score. **Brutal measure of teaching**— *faculty get no credit for what students already knew.*



NORMALIZED GAIN: **RED**-Traditional Lectures; **GREEN**-Interactive Engagement

• Hake, R. R. 1998a. Interactive-engagement vs traditional methods: A six-thousand-student survey of mechanics test data for introductory physics courses. *American Journal of Physics* 66:64-74. http://www.physics.indiana.edu/~sdi/ajpv3i.pdf

→ *TWO (OR MORE) IMPORTANT TAKE HOME POINTS? POSSIBLE APPLICATIONS?*

COVERAGE V DEEP LEARNING [STANDARDS AND RIGOR]

But what about covering the material--Can I change and still teach what they need?

1. Guppy effect & Learning Sciences. ***Assimilate it or loose it. Memory. Understanding.***

2. Tough topic for many, as it has been for me

• Nelson, C. E. 2001. What Is The Most Difficult Step We Must Take To Become Great Teachers? *National Teaching and Learning Forum* 10(4): 10-11**.** http://mypage.iu.edu/~nelson1/01_6_MostDifficult.pdf

3. *Reducing* coverage typically *increases* learning. Extra coverage typically *decreases* learning:

• Economics without Fs is one key example.

• Knight, J. K., & Wood, W. B. (2005). **Teaching more by lecturing less.** *Cell Biology Education, 4*, 298-310. Developmental biology. Replaced 1/3 of lecture with active learning. Large increases in learning.

• Wood, B. (2008). **Questions and Evidence in Life Sciences Education Research (LSER)].** *Linking Evidence and Promising Practices in STEM Undergraduate Education.* Workshop. National Research Council Board On Science Education. http://www7.nationalacademies.org/bose/PP_Agenda_1_June30_2008.html ← **NOTE MANY PAPERS**

• Sundberg MD, Dini ML. '93. Science majors vs nonmajors: Is there a difference? J College Sci Teaching 23, 299-304.

• Sundberg MD, Dini ML, Lee E. 1994. **Decreasing course content improves student comprehension** of science and attitudes towards science in freshman biology. Journal of Research in Science Teaching 1994; 31 (6): 679–93.

4. Limiting Coverage Fosters Deep (v Surface) Approaches to Learning. (Roberts → Susans) And allows active learning, attention to misconceptions, critical thinking …

• The **approach used** is ***NOT an intrinsic feature of the student*** but ***can vary from class to class.***

5. PARADOX OF COVERAGE. In Summary:

• **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 precludes consolidation of learning (memory & understanding).

• Traditional coverage precludes effective processing of misconceptions & reasoning glitches

• Traditional coverage can switch students to bulimic or surface learning, minimizing retention.

• Traditional coverage rewards memorization and inhibits the development of higher-order critical thinking and communication.

6. Steps Towards Reducing Coverage—Some examples

• **Prioritize Content:** Design a course for *one-half of available time*—forces prioritization.

• **Add Flexibility:** Designate several periods as "spare" on the syllabus.

• **Scaffold:** Easy Flip: Highlight the text by distributing *exam-ready study-questions* (v with lectures). Then reduce coverage in lecture and use the time for active processing for deep understanding.

• **Micro-lectures**: Shieh, D. 2009. *These Lectures Are Gone in 60 Seconds.* [1-3 minutes, actually]. Chronicle of Higher Education. March 6, 2009. http://chronicle.com/free/v55/i26/26a00102.htm

→ ***HOW DO YOU OR MIGHT YOU LIMIT CONTENT TO INCREASE LEARNING?***

MORE FLEXIBILITY RE EXAMS & DUE DATES CAN IMPROVE LEARNING!

Does my grading *unfairly* & *unnecessarily* favor particular groups?

Example 1: When I Give An Exam Only Once I Implicitly Assume:

a. Student Knows When She Has Achieved "A" Level Mastery
b. She Knows This so Well That She Allocates Enough Time
c. She Has Control Over Her Time & Can Make That Allocation Stick
(v Has Real Job or Is Single Parent With Sick Kids)
d. Believes the Instructor Wants & Expects Her to Succeed (v "Stereotype Threat"--Steele)

Response: Two Exams.... *v Grading Effort; v "Coverage"*

Example 2: Totally Fixed Deadlines For Papers, Lab Reports, Etc.

Responses: Revisable Papers &/Or Set Number Of Late Days

Comment: ***But… Professionals Need To Manage Time?***
Require Of Frosh v Elicit By End? Options ALLOW time-Management!! Seniors …

Example 3: My job is to teach students how to get As. Should I count initial grades?

Story: Co-valedictorian to D+ on first college English paper

Response: Intensive Freshman Seminar. Daily quizzes. Initial ones only count if As

→ ***POSSIBLE IMPLEMENTATIONS IN* YOUR *CLASSES?***

SOME DYSFUNCTIONAL ILLUSIONS OF RIGOR

Note: I am only citing illusions in this workshop that I once shared enthusiastically.

1. Hard courses weed out weak students: When students fail it is primarily due to inability, weak preparation or lack of effort.

v. ***Low grades are most often due to ineffective pedagogy***.

2. Massive grade inflation is a corruption of standards.

v. ***What we need is a lot more of the right kind of grade inflation***.

3. Traditional methods of instruction are fair to a wide range of diverse students of good ability.

v. ***Designed for and favor rich white males (and others) from great college prep programs***.

4. Students should come to us knowing how to read and write and do essay and multiple-choice questions!

v. **Each discipline has its own conventions for reading and writing. Only multiple AP courses could have taught these, *Introductory Composition cannot.***
Thus, we have to teach them in each of our classes.

5. If we cover more content, the students will learn more. v. ***Less is usually more.***

• Nelson, C. E. 2009. Dysfunctional illusions of rigor: Lessons from the scholarship of teaching and learning. In Linda B. Nilson & Judith E. Miller, Editors. *To Improve the Academy: Resources for Faculty, Instructional, and Organizational Development.* 28 [*for 2010*]:177-192. San Francisco: Jossey-Bass. [Published 10/2009]
http://mypage.iu.edu/~nelson1/10 Dysfunctional Illusions.pdf

→ **WHICH OF THESE HAVE YOU SHARED? ANY YOU ARE NOT READY TO GIVE UP?**

FUNDAMENTALS OF "MISCONCEPTIONS"

Example: Physics. *Remember that this is one of the core problems treated by Physics Education Research*

- *CAN BE* Grounded in Direct Personal Experience. Example: Proximity and warmer (cooler).
  (Several other sources: Analogies fail (plumbing and electricity), Terminology (adaptation), …)
- *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.

Great videos showing persistent misconceptions:

- Harvard-Smithsonian Center for Astrophysics. *A Private Universe.* Video. 1987. Distributed by Annenberg Media at http://www.learner.org/resources/series28.html Accessed 23 April 2009.
- Harvard-Smithsonian Center for Astrophysics. *Minds of Our Own.* Video. 1997. Distributed by Annenberg Media at http://www.learner.org/resources/series26.html Accessed 23 April 2009.

PU: "With its famous opening scene at a Harvard graduation, this classic of education research brings into sharp focus the dilemma facing all educators: ***Why don't even the brightest students truly grasp basic science concepts?"***

MOO: **"*Why is it that students can graduate from MIT and Harvard, yet not know how to solve a simple third-grade problem in science: lighting a light bulb with a battery and wire?*** Beginning with this startling fact, this program systematically explores many of the assumptions that we hold about learning to show that ***education is based on a series of myths…. the program takes a hard look at why teaching fails…***"

Other sources:

- Duit, R. 2009a. Bibliography – STCSE: Students' and teachers' conceptions and science education. ***[8,400 Citatations.*** *Keyword search, down-load, etc.]* www.ipn.uni-kiel.de/aktuell/stcse/stcse.html
- Duit, R. 2009b. Introduction, Bibliography – STCSE: Students' and teachers' conceptions and science education. http://www.ipn.uni-kiel.de/aktuell/stcse/bibint.html
- Novak, Joseph et al. *Meaningful Learning Research Group Home Page.* U. CA. Santa Cruz. [**Misconceptions, concept maps, etc.** *Downloadable articles and mapping tools*.] http://www2.ucsc.edu/mlrg/mlrghome.html

SELECTED TYPES OF MISCONCEPTIONS

- Experience misleads (Go in direction pulling v circular motion)
- Right idea misapplied (Summer due to sun closer)
- Analogies breakdown (Electric currents flow like water flows: So if leave light-bulb out …)
- ***(Mis-) Learned (Commas after trees)***
- Ambiguous Terminology: Popular v Technical (Theory); Subfields (Adaptation v Adaptation)
- ***Frequent wrong answers to conceptual fill in the blank questions are often misconceptions***

[You can use these to create multiple choice preliminary concept inventories. If used as pretests and posttests these are a measure of the ***effectiveness of your learning design.***]

CONCEPTUAL CHANGE: EXAMPLE: Structured Classroom Demonstrations

- Crouch, Catherine H., A. P. Fagen, P. Callan and E. Mazur. 2004. **Classroom Demonstrations: Learning Tools or Entertainment?** *American J. Physics*, **72**, 835-838.

[Straight demos have no effect. Add prediction with discussion, do demo, then more answers and interactions.]

The ideal approach enables students to ***make their prior knowledge explicit*** *and to* ***compare these ideas with those of other students*** *and* ***then provides activities that foster cognitive conflict*** *and subsequently* ***favor the restructuring, consolidation and awareness*** *of new learning*.

→ APPLY: Points in your course where you can apply conceptual change strategies:

- *Have students make their initial ideas explicit* (predictions) *and compare these with those of other students*
- *Provide activities that foster Cognitive conflict* (if initially wrong) or *reinforcement* (if initially right)
- *Provide discussion, application etc. activities to foster restructuring, consolidation & awareness of new ideas*
- This workshop?

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??

KEY CONCLUSIONS FROM EXTENSIVE SOTL EVIDENCE:
• Most low grades in college courses could be eliminated by using revised learning designs.
• Revised learning and curricular designs can produce large increases in higher order skills

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.

MISCONCEPTIONS. EXAMPLE 2*: 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

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.

→ APPLICATIONS SUMMARY

Which key ideas from this workshop are you already using?

Which additional ones are you now ready to implement?

What evidence or arguments might help you adopt some others?

. SOME IMPORTANT BASIC RESOURCES *[TAKE-HOME]*

AIM HIGH: Focus on Major Outcomes

• Marcia Baxter Magolda. 2001. *Making Their Own Way: Narratives for Transforming Higher Education to Promote Self-Development. S*tylus. [Fundamental liberal education including critical thinking, mature valuing. & self-authorship]
• Marcia Mentkowski and Associates 1999. *Learning that Lasts* Jossey-Bass. (Alverno and beyond)

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

• John Bean. 1996*. Engaging Ideas: The professor's Guide to Integrating Writing, Critical Thinking, and Active learning in the Classroom.* Jossey-Bass.
• L. Dee Fink. 2003. *Creating Significant Learning Experiences: An Integrated Approach to Designing College Courses*. Jossey-Bass.**]**
• Grant Wiggins & Jay McTighe. 2000. *Understanding by Design*. Assoc. for Supervision & Curriculum Development.

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:

• Tom A. Angelo & K. Patricia Cross. 1993. *Classroom Assessment Techniques.* 2nd edit. Jossey-Bass. Related examples online as *Classroom Assessment Techniques* http://www.siue.edu/%7Ededer/assess/catmain.html and *FLAG (**Field-Tested Learning Assessment Guide for Science, Math, Engineering, & Technology**)* http://www.flaguide.org/

Course Portfolios.

• Pat Hutchings (Ed). 1998. *The Course Portfolio: How Faculty Can Examine Their Teaching To Advance Practice And Improve Student Learning.* Stylus.
• Daniel Bernstein et al. 2006. *Making Teaching and Learning Visible: Course Portfolios and the Peer Review.* Anker.
• Carmen Werder. 2000. *How to prepare a course portfolio.*
http://pandora.cii.wwu.edu/cii/resources/portfolios/preparation.asp

LOOK BROADLY Two Major Collections of Teaching Resources:

• Bernice A. Pescosolido & R. Aminzade, Eds. 1999. *The Social Worlds of Higher Education: Handbook for Teaching in a New Century.* Pine Forge Press [55+ articles]. With a companion CD: *Field Guide for Teaching in a New Century: Ideas from Fellow Travelers.* (Includes70+ additional items on pedagogical techniques.)
• K. A. Feldman, & M. B. Paulsen, Eds. 1998. *Teaching and Learning in the College Classroom.* 2nd Edit. ASHE Reader / Ginn Press [50+ articles. ASHE = Association for the Study of Higher Education] ***Revision in press***.

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
• **POD-IDEA Center, *Notes on Learning.*** Free PDFs. http://www.theideacenter.org/PODNotesLearning

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

• *Authoring Your Life: Developing an Internal Voice to Navigate Life's Challenges*. Marcia B. Baxter Magolda, (2009). [Important read for faculty and student advisors, too] **
• *Developing Textbook Thinking: Strategies for Success in College.* Sherrie Nist & William Diehl (2001) *
• *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) *
• *Urban Learners: Serious About College Success* (3rd Edition). Robert De Lucia (2002)