

# Active Learning and Assessment

Symposium on the Use and Assessment of  
Active Learning in Mathematics

August 3, 2016

**Zach Kornhauser**

*Associate Director, Assessment and Evaluation,*  
Center for Teaching and Learning  
[zk2124@columbia.edu](mailto:zk2124@columbia.edu)

**Suzanna Klaf**

*Associate Director, Faculty Teaching Initiatives and  
Program, Center for Teaching and Learning*  
[sk4189@columbia.edu](mailto:sk4189@columbia.edu)

 COLUMBIA | CTL  
Center for Teaching and Learning

## Agenda

- Issues in STEM education
- Active Learning - what is it? And why use it?
- CTL approach to promoting Active Learning
- Forms of assessment of Active Learning
- Scholarship of Teaching & Learning (SoTL)

# Issues in STEM Education

What do we know?

- Decrease in STEM degrees conferred
- Increase in STEM employment opportunities
- Increase in need and value of STEM degree holders
- STEM pedagogies: In need of improvement



## What is Active Learning?

- "Anything that involves students in **doing things** and **thinking about the things they are doing**" (Bonwell & Eison, 1991, p. 2).
- "Anything course-related that all students in a class session are **called upon to do** other than simply watching, listening and taking notes" (Felder & Brent, 2009, p.2).

Bonwell, C. C., & Eison, J. A. (1991). *Active learning: Creating excitement in the classroom (ASHE-ERIC Higher Education Rep. No. 1)*. Washington, DC: The George Washington University, School of Education and Human Development.

Felder, R.M. & Brent, R. (2009). Active learning: An introduction. *ASQ Higher Education Brief*, 2(4).

# Characteristics of Active Learning

- Students do more than listen
- More emphasis on developing skills than transmitting information
- Higher-order skills are targeted
- Engages students in activities
- Places emphasis on exploration of students attitudes and values

Bonwell, C. C., & Eison, J. A. (1991). *Active learning: Creating excitement in the classroom (ASHE-ERIC Higher Education Rep. No. 1)*. Washington, DC: The George Washington University, School of Education and Human Development.

# Why use Active Learning?

**Does Active Learning Work? A Review of the Research**

MICHAEL PRINCE  
Department of Chemical Engineering  
Rutgers University

**ABSTRACT**

This study examines the evidence for the effectiveness of active learning. It defines the common forms of active learning most common in engineering faculty and critically reviews the most relevant support for the use of active learning, collaborative, cooperative and problem-based learning.

**INTRODUCTION**

Active learning has received considerable attention over the past several years. Often presented or perceived as a radical change from traditional instruction, the topic frequently captures faculty. Active learning has attracted strong advocates among faculty looking for alternatives to traditional teaching methods, while skeptical faculty regard active learning as another in a long line of educational fads.

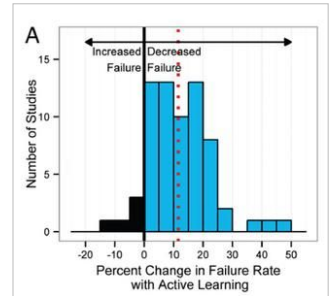
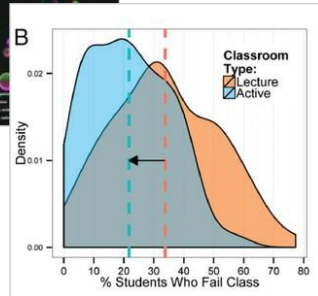
The most widely cited source regarding active learning is a review by Prince (2004) in the *Journal of Engineering Education*. This review addresses the question of whether active learning is and how it differs from traditional engineering education, when this is already "best" through teamwork, engagement and observation. Adding to the confusion, engineering faculty do not always understand how the common forms of active learning differ from each other and most engineering faculty are not inclined to compare the educational literature to research.

The study addresses such of these issues. First, it defines active learning and distinguishes the different types of active learning most frequently discussed in the engineering literature. A core definition is provided for each of these common methods to allow self-identification by those who are not familiar with the terminology. Second, the study provides an overview of the most relevant research on the effectiveness of active learning from the educational literature. Finally, it assesses engineering faculty by summarizing some of the most relevant literature in the field of active learning.

**DEFINITIONS**

It is not possible to provide universally accepted definitions for all of the vocabulary of active learning, since different authors in the field have interpreted some terms differently. However, it is possible to provide some generally accepted definitions and to highlight distinctions in how common terms are used.

July 2004 *Journal of Engineering Education* 1



Prince, M. (2004). Does Active Learning Work? A Review of the Research. *Journal of Engineering Education*, 93(3), 223-231.

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

# Center for Teaching and Learning (CTL) Approach



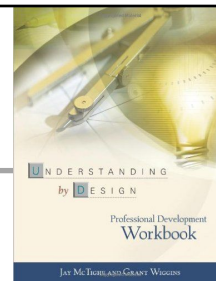
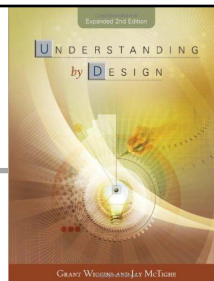
- Supporting excellence and innovation in teaching
- Advancing a culture of teaching and learning

 COLUMBIA | CTL  
Center for Teaching and Learning



 COLUMBIA | CTL  
Center for Teaching and Learning

# Backward Design



Framework Reference: Wiggins & McTighe.



## Activity: Think-Partner-Share

### Teaching & Learning Context:

*Who are your students? What are their learning needs?*

**Objectives:** *What do you want your students to know, be able to do, and value?*

**Assessment:** *What evidence of student learning is acceptable?*

**Learning experiences & instruction:** *What active learning strategies and engaged pedagogies do you use in your courses?*





**active learning institute**  
flipped classrooms and beyond

July 12 - 14, 2016 • 9am - 3pm  
Center for Teaching and Learning (212 Butler Library)

**About**

The Center for Teaching and Learning invites faculty to participate in a hands-on Active Learning Institute: Flipped Classrooms and Beyond to transform their undergraduate and graduate-level courses into an environment for participatory and engaged learning. This intensive workshop introduces the key components of course redesign to increase active learning and can also help prepare instructors to flip their courses.

The Institute is open to Columbia faculty and designated graduate teaching assistants.

Participants will continue to receive guidance and consultations from CTL staff beyond the Institute.

**Learn**

Specific topics will include: **Learning Objectives and Syllabus Development** "Behind the Scenes" of Planning for Active Learning

**Facilitating Individual and Collaborative Learning Activities**

**Planning and Creating Effective Online Materials** **Evaluating Learning and Assessing Impact**

**Creating Community in the Classroom**

**Create**

Instructors will leave the Institute having created:

A redesigned, learner-centered syllabus

Drafts of pre-class and in-class activities or assignments for a single class session

Sample online materials, such as videos or podcasts

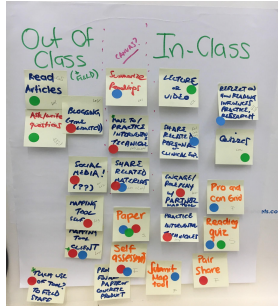
A timeline for planning, developing, and assessing the impact of their course

**Apply Today!**

To apply for the Summer 2016 Institute, please complete the application at <http://bit.ly/ALI-2016> by May 20, 2016.

ctl.columbia.edu | ColumbiaCTL@columbia.edu  
212-654-1692

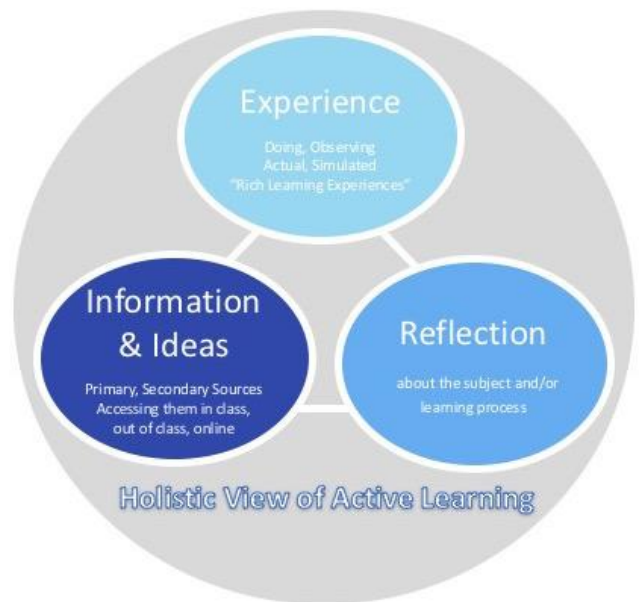
COLUMBIA | CTL  
Center for Teaching and Learning




Active Learning Institute photographs (July 12-14, 2016).

# Holistic View of Active Learning

Fink, L.D. (2013). *Creating Significant Learning Experiences: An Integrated Approach to Designing College Courses*. 2nd Edition. San Francisco, CA: Jossey-Bass.



# Resources

**IDEA PAPER #53** 

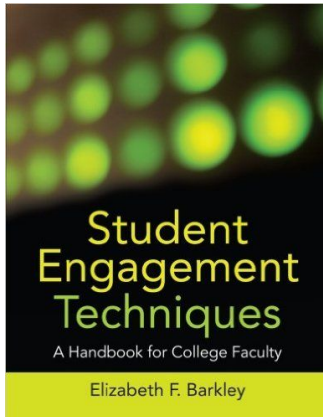
**Active Learning Strategies in Face-to-Face Courses**  
Barbara J. Millis • The University of Texas at San Antonio

**Abstract**  
An extensive research studies suggest teachers who desire increased student learning should adopt active learning. This article explores the research, defines active learning, discusses its value, offers suggestions for implementing it, and provides an annotated bibliography of active learning approaches. Thinking About This Problem-Solving, Three-Step Interview, Think-Pair-Share, Visible Quiz, Value Line, and Speed-Peak are Problem-Solving.

**Lecturing**, a time-tested and long-recognized teaching method, remains the most frequent method of instruction in higher education throughout the world (Dunlap & Bruckner, 2012; Lantieri, 2012, p. 2). The most prominent shift identified among teaching practices who are also global studies, the list of other studies is provided. Observations from the lecture, in the active learning, "involvement," "the message," or doing "other" activities, learning practices, and active learning. It provides a comprehensive and efficient way to deliver content to large numbers of students, particularly in large lecture halls.

**Lecturing has advantages**. It is: enables the instructor to supplement the lecture by providing ongoing review, allows the instructor to present "content" in an organized, although virtually impossible may be difficult to do during the hour of material lecture. This is possible in offering content. It is the instructor who has information that students are probably expected to do the same time, and it offers an opportunity for an engaging lecture to transfer students.

**Despite these perceived advantages**, most studies of student in recent years—particularly in the area of cognitive science, psychology, and neuroscience—have shown that the lecture conditions of any educator lack an active learning and may reduce student learning. Active learning is a viable alternative of the new trend toward what is now commonly called "hands-on" or "experiential" learning (Barkley, 2009; 2012). It involves students, rather than passive students learning, their active learning is an essential component of effective teaching. As a result,



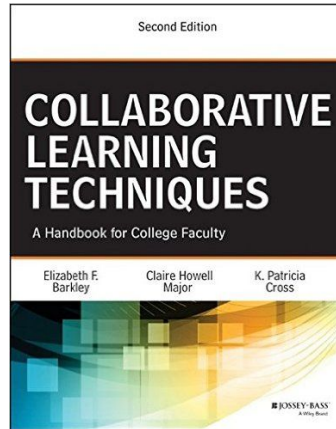
**Student Engagement Techniques**  
A Handbook for College Faculty  
Elizabeth F. Barkley

Barkley, E.F. (2009). *Student Engagement Techniques: A Handbook for College Faculty*. Jossey-Bass.

Second Edition

**COLLABORATIVE LEARNING TECHNIQUES**  
A Handbook for College Faculty

Elizabeth F. Barkley Claire Howell Major K. Patricia Cross



JOSSEY-BASS  
A Wiley Brand

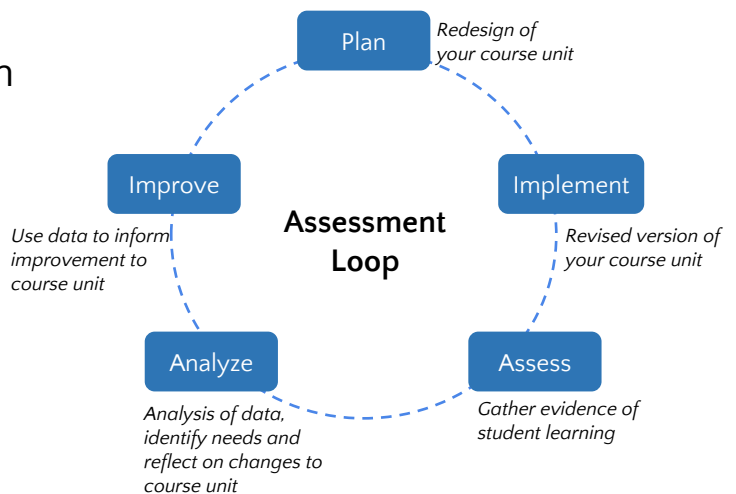
Barkley, E.F., Major, C., and Cross, K.P. (2014). *Collaborative Learning Techniques: A Handbook for College Faculty*. Jossey-Bass.

Millis, B. (2012). IDEA Paper #53. Active Learning Strategies in Face-to-Face Courses. The IDEA Center.

## Assessment in the Active Classroom




- To provide feedback on student learning for both students and instructor.
- To measure students' preparedness for the next course unit.
- To direct students' learning.



# Assessment Strategy

1. How are you currently assessing student learning in your unit?
2. How can you articulate the **alignment** of assessment methods with learning objectives?
3. Where are students completing assessments: **in-class** and/or **outside of class**?
4. What **types** of methods are these?



Day 1 Worksheet  
Assessing Student Learning in Your Course Unit

**Stage 2 of Backward Design: Determine Acceptable Evidence**  
Plan for formative and summative ways to assess student knowledge and skills.

In the space below, indicate: (a) the formative and summative assessments in your course unit as they align to your unit learning objectives; (b) where these are occurring (out-of-class or in-class); (c) whether students complete these assessments: individually, pairs, groups and why; and (d) specify if students will have opportunities to self-assess their performance.

Learning Objective	Out-of-class Assessment	In-class Assessment
LO1		
LO2		
LO3		
LO4		

# Types of Assessment

Formative	Summative
<i>Low stake (no or low point value)</i> Goal: Monitor student learning	<i>High stakes (high point value)</i> Goal: evaluate student learning
<p><i>Examples:</i></p> <ul style="list-style-type: none"> <li>● Draw a concept map to represent understanding of a topic</li> <li>● Submit 1-2 sentences summarizing the main point of a lecture</li> <li>● Turn in a research proposal for early feedback</li> <li>● Solve sample problems in groups</li> </ul>	<p><i>Examples:</i></p> <ul style="list-style-type: none"> <li>● Midterm exam</li> <li>● Final project</li> <li>● A research paper</li> </ul>



# CATs

## Classroom Assessment Techniques (CATs)

- Provide formative feedback on student learning
- Identify CAT(s) that are appropriate for your course unit.

**50 Classroom Assessment Techniques (CATs)**  
Source: Angelo, T.A., and Cross, K.P. (1993). *Classroom Assessment Techniques: a Handbook for College Teachers*. San Francisco, CA: Jossey-Bass.

**Techniques for Assessing Course-Related Knowledge & Skills**

**I. Assessing Prior Knowledge, Recall, and Understanding**

The CATs in this group are recommended to assess declarative learning, the content of a particular subject.

1. **Background Knowledge Probe:** short, simple questionnaires prepared by instructors for use at the beginning of a course or at the start of new units or topics; can serve as a pretest; typically elicits more detailed information than CATs.
2. **Focused Listing:** focuses students' attention on a single important term, name, or lesson or class session and directs students to list ideas related to the "focus."
3. **Misconception/Preconception Check:** focus is on uncovering prior knowledge or block new learning; can be designed to uncover incorrect or incomplete knowledge values.
4. **Empty Outlines:** in a limited amount of time students complete an empty or partial outline of an in-class presentation or homework assignment.
5. **Memory Matrix:** students complete a table about course content in which row and are complete but cells are empty.
6. **Minute Paper:** perhaps the most frequently used CAT; students answer a question: most important thing you learned during this class? And What important question remains unanswered?
7. **Muddiest Point:** considered my many as the simplest CAT; students respond to a question: the muddiest point in \_\_\_\_\_?; well suited to large, lower division courses but emphasize integration, synthesis and evaluation.

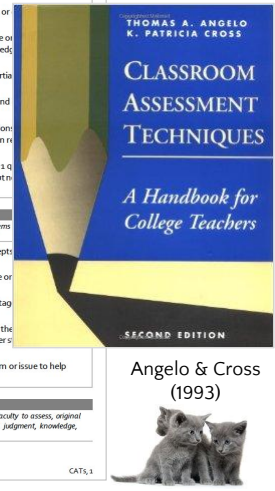
**II. Assessing Skill in Analysis and Critical Thinking**

The CATs in this group focus on analysis—the breaking down of information, questions, or problems understanding and problem solving.

8. **Categorizing Grid:** student complete a grid containing 2 or 3 overarching concepts related subordinate elements associated with the larger concepts.
9. **Defining Features Matrix:** students categorize concepts according to presence or important defining features.
10. **Pro and Con Grid:** students list pros/cons, costs/benefits, advantages/disadvantages or value of competing claims.
11. **Content, Form, and Function Outlines:** in an outline form, students analyze the "how" (form), and "why" (function) of a particular message (e.g. poem, newspaper's critical essay); also called "What, How, & Why Outlines".
12. **Analytic Memos:** students write a one- or two-page analysis of a specific problem or issue to help inform a decision-maker.

*the faculty to assess, original  
ence, judgment, knowledge,*

CATs.1



See 50 CATs handout



# Evaluating Your Active Learning Experience

## ● Did it work? How will you know?

- Based on previous iterations of the unit, did your students' learning improve as a result of the new model?

## ● Plan to evaluate by reflecting on redesigned unit

- Did you communicate ideas effectively?
- Did you provide enough opportunities for students to practice?
- Was it challenging enough?

## ● Ask for feedback from students on what worked well and what could be improved – update your unit accordingly.

Day 3 Worksheet  
**Evaluating Your Redesigned Course Unit**  
Did it work? How will you know?

Plan opportunities to collect information and to reflect on the redesign of your course unit. What worked about the active learning components or "flg"? What needs improvement? How will you know? Did your students' learning improve as a result of the new model? What components of the redesign were particularly reflected? Compare to previous iterations of the unit, reflect on the outcomes, and ask for students to reflect on their learning and to provide you with feedback.

Components of the unit you would like feedback on (e.g., content or model course materials, technologies used, in-class activities)	Methods / tools you will use to collect feedback (e.g., in-classroom activities, student conversations, focus groups, reflective journal)	Timing the collection of feedback (When will you collect feedback (e.g., during the unit and after the unit, mid-term, end of term)?)

# Assessment of Active Learning

- Indicators from the literature...
  - Academic success
  - Pre- and post-test comparison: Content and/or skills
  - Performance on tests measuring higher-order skills
  - Interpersonal relationships with peers and instructors
  - Satisfaction with college experience
  - Attitudes towards learning and subject area

# Measuring Active Learning

## Scales / Questionnaires

- Classroom Survey of Student Engagement (CLASSE) (Ouimet & Smallwood, 2005)
- Motivation and Study Process Questionnaires

## Observations

- Classroom Observation Protocol for Undergraduate STEM (COPUS; Smith, Jones, Gilbert, & Weiman, 2013)
- Teaching Dimensions Observation Protocol (TDOP)

The screenshot displays the NSSE website interface. At the top, it says 'national survey of student engagement'. Below this, there are navigation links: 'ABOUT NSSE', 'NSSE FINDINGS', 'ADMINISTERING NSSE', 'TOOLS & SERVICES', 'STUDENTS & PARENTS', and 'MEDIA'. The main content area is titled 'Classroom Survey of Student Engagement (CLASSE)'. It includes a sidebar with navigation options like 'ARRANGEMENTS IN DEPTH', 'STAFF', 'ADVISORS', 'PARTNERS', 'POSITIONS & POLICIES', 'STUDENTS & PARENTS', 'MEDIA', and 'EMPLOYMENT'. The main text describes CLASSE as a classroom-level survey and provides instructions on how to use it. A search bar is located in the top right corner. At the bottom of the page, there is a logo for 'TDOP Teaching Dimensions Observation Protocol' and a small text box with the URL 'http://www.nesr.edu/tdop/'.

# Measuring Active Learning

## Tests

- Collegiate Learning Assessment Plus (CLA+)
- Classroom Test of Scientific Reasoning (Lawson, 1978)

## Other / Inventories

- Classroom Assessment Techniques (CATS; Angelo & Cross, 1993)
- AAC&U VALUE Rubrics
- Teaching Practices Inventory (Wieman & Gilbert, 2014)

Association of American Colleges & Universities  
A VOICE AND A FORCE FOR LIBERAL EDUCATION IN THE 21ST CENTURY

Home | About | Meetings | Publications & Research

Home > VALUE > VALUE Rubric Development Project

### VALUE Rubric Development Project

The original VALUE initiative in 2007-08 involved team faculty and other educational professionals from over 100 higher education institutions engaged over many months in developing 16 VALUE rubrics for the LEAP Essential Learning Outcomes. Each rubric was developed from the most frequently identified characteristics or criteria of learning each of the 16 learning outcomes. Drafts of each rubric were then tested by faculty with their own students' work on over 100 college campuses.

Download the Rubrics

As part of AAC&U's Liberal Education and America's Promise (LEAP) initiative, the VALUE rubrics contribute to the national dialogue on assessment of college student learning. Since the initial release of the rubrics, more than thirty-two thousand first-time individuals have visited the VALUE website between June 2010 and January 2014. The VALUE rubrics have been viewed at more than 400 hundred discrete institutions, including schools, higher education associations, and more than thirty-three hundred colleges and universities in the United States and around the world.

See the VALUE Project Toolkit page for additional resources and examples of rubric use.

AAC&U acknowledges the generous support from the State Farm Companies Foundation and the Fund for the Improvement of Post-Secondary Education (FIPSE).

- Suppose you are given two clay balls of equal size and shape. The two clay balls also weigh the same. One ball is flattened into a pancake-shaped piece. Which of these statements is correct?
  - The pancake-shaped piece weighs more than the ball
  - The two pieces still weigh the same
  - The ball weighs more than the pancake-shaped piece
- because
  - the flattened piece covers a larger area.
  - the ball pushes down more on one spot.
  - when something is flattened it loses weight.
  - clay has not been added or taken away.
  - when something is flattened it gains weight.
- To the right are drawings of two cylinders filled to the same level with water. The cylinders are identical in size and shape.
 

Also shown at the right are two marbles, one glass and one steel. The marbles are the same size but the steel one is much heavier than the glass one.

When the glass marble is put into Cylinder 1 it sinks to the bottom and the water level rises to the 6th mark. If we put the steel marble into Cylinder 2, the water will rise

  - to the same level as it did in Cyl 1
  - to a higher level than it did in Cyl 1
  - to a lower level than it did in Cyl 1
- because
  - the steel marble will sink faster.
  - the marbles are made of different materials
  - the steel marble is heavier than the glass marble creates less of a displacement
  - the marbles are the same size.

## Assessment Tools

Symposium (August 3, 2016)

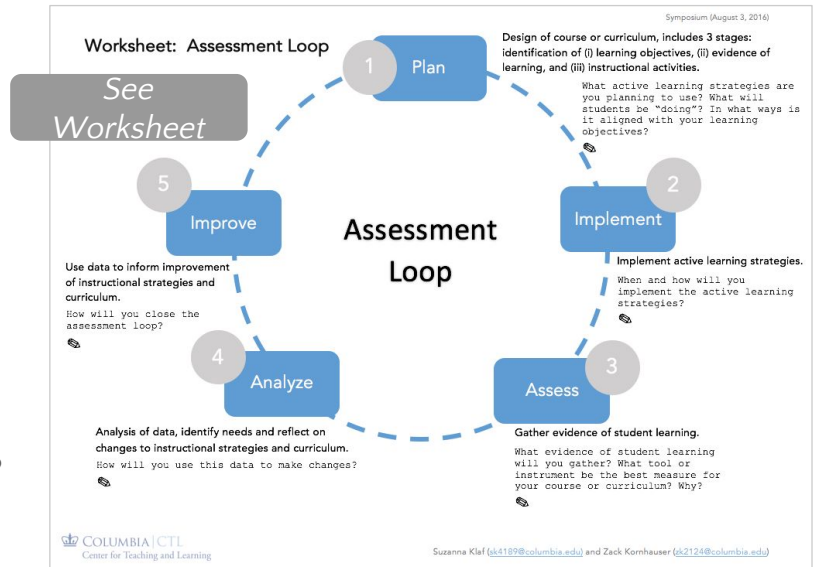
See handout for summary

Name of Tool	Type	Purpose and method	Considerations
CLASSE (Oulmet & Smallwood, 2005)	Scale/ Questionnaire	<ul style="list-style-type: none"> <li>Survey to students and faculty</li> <li>Assesses student engagement in a course</li> </ul>	<ul style="list-style-type: none"> <li>Asks students how frequently they engage in various practices</li> <li>Asks faculty how important various practices are in facilitating student success</li> <li>Responses are contrasted to determine educational practices that are occurring less frequently than expected</li> </ul>
Questionnaire (Glynn, 2011)	Scale/ Questionnaire	<ul style="list-style-type: none"> <li>5 item scale with 5 choices per scale</li> <li>Assesses students' motivations to learn science in college and high schools</li> </ul>	<ul style="list-style-type: none"> <li>Can help instructors determine students' motivation to learn science at an individual level, at a class level, or to examine change over time</li> </ul>
Motivation Strategies for Learning Questionnaire (MSLQ; Pintrich & Degroot, 1990)	Scale/ Questionnaire	<ul style="list-style-type: none"> <li>44 item Likert instrument with 7 choices</li> <li>Designed to assess college students' motivational orientations and use of different learning strategies</li> </ul>	<ul style="list-style-type: none"> <li>Guiding theory is that students' motivations are important mediators for instructional methods</li> </ul>
Study Process questionnaire (Biggs, Kember, Leung, 2000)	Scale/ Questionnaire	<ul style="list-style-type: none"> <li>20 item Likert measure with five choices per item</li> <li>Evaluates college students' learning approaches</li> </ul>	<ul style="list-style-type: none"> <li>Yields information about students' use of surface and deep approaches</li> <li>Psychometrically strong</li> </ul>
Classroom Observation Protocol for Undergraduate STEM (Smith, Jones, Gilbert, & Weiman, 2013)	Observation	<ul style="list-style-type: none"> <li>Protocol allows an observer to characterize how faculty and students are spending time in the classroom</li> <li>Observers document classroom behaviors in two minute intervals</li> </ul>	<ul style="list-style-type: none"> <li>Codes behaviors into what students are doing and what instructors are doing</li> <li>Much less training needed (1-2 hours) than other observation instruments</li> </ul>
Teaching Dimensions Observation Protocol (Hora, Oleson, Ferrara, 2013)	Observation	<ul style="list-style-type: none"> <li>Structured observation protocol designed to capture nuances of teaching behaviours in a descriptive manner</li> <li>Codes made every two minutes</li> </ul>	<ul style="list-style-type: none"> <li>Captures an expansive array of characteristics (46 possible codes)</li> <li>Typically requires ~3 days of training</li> </ul>
Name of Tool	Type	Purpose and method	Considerations



# Activity: Assessment Loop

- How do you know if the active learning strategies you used were effective?
- What changes might you make to the learning experience and your instruction?



## Current trends in the literature...

- Focus on flipping the classroom
  - Even for large classes (Rodriguez, 2016; Eichler & Peeples, 2016)
- Getting faculty to adopt active learning classrooms
  - Issues with faculty adopting active learning classrooms (Van Horne & Murniati, 2016)
  - Using a mentorship model for faculty to adopt active learning classrooms (Grimes & White, 2015)
- Using active learning to address the achievement gap (Cooper, 2015)
- "Alternative" ways of promoting active learning in the class
  - Students modeling molecular models with their bodies (Voltzow, 2016)
  - Promoting active learning through students answering online questions outside of class (Gibson, 2015)
  - Using storytelling to engage students genetics in a genetics course (Moitra, 2014)



**MAA 100**  
 MATHEMATICAL ASSOCIATION OF AMERICA

CELEBRATING A CENTURY OF  
 ADVANCING MATHEMATICS

LOGIN JOIN SHOP GIVE

Membership MAA Press Meetings Competitions Community Programs News About MAA

**MAA Press**

Periodicals

Books

eBooks

Browse

Textbooks

MAA Reviews

Mathematical Communication

Information for Libraries

Author Resources

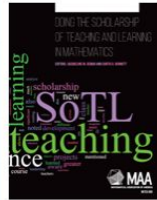
Advertise with MAA

Home » MAA Press » eBooks » Doing the Scholarship of Teaching and Learning in Mathematics

## Doing the Scholarship of Teaching and Learning in Mathematics

Jacqueline M. Dewar and Curtis D. Bennett, Editors

(Dewar & Bennett, 2015)  
 Loyola Marymount University



The Scholarship of Teaching and Learning (SoTL) movement encourages faculty to view teaching "problems" as invitations to conduct scholarly investigations. In this growing field of inquiry faculty bring their disciplinary knowledge and teaching experience to bear on questions of teaching and learning. They systematically gather evidence to develop and support their conclusions. The results are to be peer reviewed and made public for others to build on.

This Notes volume is written expressly for collegiate mathematics faculty who want to know more about conducting scholarly investigations into their teaching and their students' learning. Envisioned and edited by two mathematics faculty, the volume serves as a how-to guide for doing SoTL in mathematics.

The four chapters in Part I provide background on this form of scholarship and specific instructions for undertaking a SoTL investigation in mathematics. Part II contains fifteen examples of SoTL projects in mathematics from fourteen different institutions, both public and private, spanning the spectrum of higher educational institutions from community colleges to research universities. These chapters "reveal the process of doing SoTL" by illustrating many of the concepts, issues, methods and procedures discussed in Part I. An Editors' Commentary opens each contributed chapter to highlight one or more aspects of the process of doing SoTL revealed within. Toward the end of each chapter the contributing authors describe the benefits that accrued to them and their careers from participating in SoTL.

Print on Demand



# Activity: Scholarship of Teaching and Learning (SoTL)

- How might you contribute to the scholarship?
- What question(s) might you pose?

See SoTL handout

Symposium (August 3, 2016)

### Contributing to the Scholarship of Teaching and Learning (SoTL)

What do you want to know about the impact of active learning strategies on your students' learning?

#### Developing an active learning and assessment project:

Identify the Research Question	Clearly and succinctly identify research question(s). What questions might you pose?
Conduct Literature Review	Identify discipline-specific and general SoTL publications that relate to your study and which you will build upon.
Design the study & Research Methodology	What population do you want to study? How many people will you need to study? Where and when will you conduct the study? What type of design will you use?
Instrument & Outcomes	What instrument will you use? What kinds of outcomes do you expect?
Collect the Data	What data will you collect? (quantitative, qualitative, or a combination)? When will you collect them? Who will collect the data? Why are you collecting these data?
Analyze the data and draw conclusions	How will you analyze the data? What type of analysis will you use and why?
Report the findings	Where do you plan to present or publish your findings? How do you plan to disseminate your findings? (e.g.,

COLUMBIA | CTL  
 Center for Teaching and Learning

Suzanna Klaf (sk4189@columbia.edu) and Zach Kornbuser (z2121@columbia.edu)

Doing the Scholarship of Teaching and Learning: A Guide to the Process, and How to Do It  
 by Dewar and Bennett (2015), p. 28.



# CIRTL



## CIRTL Network

Committed to advancing the teaching of  
STEM disciplines in higher education

Center for the Integration of Research, Teaching and Learning

<http://www.cirtl.net/>

**Change**  
THE MAGAZINE OF HIGHER LEARNING

ABOUT US CONTACT US TERMS & CONDITIONS

MAY-JUNE 2009

Print Email Resize Text: Original Large XLarge RSS FEED

**Leveraging the NSF Broader-Impacts Criterion for Change in**  
by Robert D. Mathieu, Christine Pfund, and Don Gillian-Daniel

The call for a more scientifically literate society is a constant drumbeat coming from the mainstream media and from reports of concerned organizations like the National Academy of Sciences. And they see improved education and outreach from institutions of higher learning as key to any proposed solution to this major national challenge. In higher education, the need to integrate research, teaching, and learning has been a theme woven through decades of calls for improvement. In reality, the weight of external research funding has tipped the scales at universities—and increasingly more often at colleges—toward research activities. Any associated gains in the teaching and learning of undergraduates are seen as collateral, albeit very real, benefits.

In an attempt to move, if not balance, the scales of activity toward increasing scientific capability across a diverse national population, U.S. federal funding agencies are purposefully linking research funding to broad national impact. Some U.S. federal funding agencies, such as the National Science Foundation (NSF) are now insisting that scientists describe how their proposed research will have “broader impacts.” Activities of researchers must contribute not only to the growing fund of knowledge but to the more immediate national good.

Mathieu, Pfund, and Gillian-Daniel (2009)

**COLUMBIA | CTL**  
Center for Teaching and Learning

**Columbia joins network to better prepare future STEM faculty in the U.S. and Canada**  
by Columbia CTL | Feb 29, 2016 | Announcements, Faculty

Columbia University has joined the Center for the Integration of Research, Teaching and Learning (CIRTL), established in 2003 with support from the National Science Foundation to improve teaching skills and increase the diversity of future university faculty in science, technology, engineering and mathematics (STEM) fields.

Columbia University is among several new members joining CIRTL during a recent expansion of the network’s membership. All of CIRTL’s members commit to developing local learning communities that promote proven teaching and mentoring techniques for STEM graduate students.

“It is an honor to welcome such a distinguished institution as Columbia University to our network,” said Robert Mathieu, director of CIRTL. “We are excited Columbia University is joining with other top research universities dedicated to strengthening the teaching skills of our nation’s future STEM faculty.”

# Active Learning and Assessment

## Symposium on the Use and Assessment of Active Learning in Mathematics

August 3, 2016

**Zach Kornhauser**

Associate Director, Assessment and Evaluation,  
Center for Teaching and Learning  
[zk2124@columbia.edu](mailto:zk2124@columbia.edu)

**Suzanna Klaf**

Associate Director, Faculty Teaching Initiatives and  
Program, Center for Teaching and Learning  
[sk4189@columbia.edu](mailto:sk4189@columbia.edu)