Active Learning and Assessment

Symposium on the Use and Assessment of Active Learning in Mathematics

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Zach Kornhauser
Associate Director, Assessment and Evaluation, Center for Teaching and Learning
zk2124@columbia.edu

Suzanna Klaf
Associate Director, Faculty Teaching Initiatives and Program, Center for Teaching and Learning
sk4189@columbia.edu

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

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**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).


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


Why use Active Learning?


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
Backward Design

1. Identify desired results
2. Determine acceptable evidence
3. Plan learning experiences and instruction

_Framework Reference: Wiggins & McTighe._

Activity: Think-Pair-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?
Holistic View of Active Learning

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.
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?

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### Types of Assessment

<table>
<thead>
<tr>
<th>Formative</th>
<th>Summative</th>
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<tbody>
<tr>
<td><strong>Low stake (no or low point value)</strong></td>
<td><strong>High stakes (high point value)</strong></td>
</tr>
<tr>
<td>Goal: Monitor student learning</td>
<td>Goal: evaluate student learning</td>
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**Examples:**
- Draw a concept map to represent understanding of a topic
- Submit 1-2 sentences summarizing the main point of a lecture
- Turn in a research proposal for early feedback
- Solve sample problems in groups

**Examples:**
- Midterm exam
- Final project
- A research paper
CATs

Classroom Assessment Techniques (CATs)

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

Evaluate 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.
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)
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)

Assessment Tools

<table>
<thead>
<tr>
<th>Name of Tool</th>
<th>Type</th>
<th>Purpose and method</th>
<th>Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLASE (Chow, 2003)</td>
<td>Scale/ Questionnaire</td>
<td>A new tool that assesses student engagement in a course</td>
<td>Helps instructors determine students' motivations to learn science in college and high schools</td>
</tr>
<tr>
<td>Motivation Strategies for Learning Questionnaire (MSLQ; Petrunak &amp; DiPietro, 1986)</td>
<td>Scale/ Questionnaire</td>
<td>A 4-item Likert instrument with five choices per item</td>
<td>Relates to changes in student engagement and improves retention strategies</td>
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<td>Study Process Questionnaire (Biggs, 1995)</td>
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See handout for summary
**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?

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**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)
Activity: Scholarship of Teaching and Learning (SoTL)

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

See SoTL handout
Mathieu, Pfund, and Gillian–Daniel (2009)