Introduction to the workshop

Active learning is one of the most powerful teaching approaches you can use to maximize your students’ learning. That’s why we’ve created this tutorial and workshop to help you familiarize yourself with the basics of active learning, to provide you with some guidance for preparing to teach a lesson that uses active learning, and to offer you an opportunity to practice teaching.

During the Microteaching workshop on September 4, 2014, you will teach a 10 minute lesson that incorporates active learning to a small cohort of fellow participants and receive personalized feedback from a professional teaching consultant from CETL.

In order to participate in the microteaching, here is what you should do:

1. Read through the information in each of the sections of the active learning workshop.
2. Complete the exercises and reflection questions.
3. Post the most interesting insights to the discussion forum on the T-Square site. (You were added to the site when you registered for the workshop.)
4. Prepare your lesson plan as instructed in the final workshop section. For early feedback from a CETL consultant, please submit it no later than August 21, 2014. You may submit the lesson plan after this date and still participate in the microteaching, but we cannot guarantee early feedback in that case. Send your lesson plans to csubino@ctel.gatech.edu.

Out of respect for the effort of all of the participants and the consultants, please understand that we will not allow individuals who have not completed this tutorial and submitted a lesson plan to participate in the microteaching.

Outline of the Workshop:

1. Why build in active learning to your teaching approach?
2. What is active learning?
3. What evidence exists that active learning is effective in promoting student learning?
4. What active learning strategies should you use to support your learning goals?
5. What are some examples of active learning strategies?
6. How can you anticipate and address student resistance to active learning?
7. What lesson will you teach for the microteaching?
I: Why build in active learning?

THE PROBLEM:

Scenario 1—the instructor’s view: You have just given a brilliant lecture on a very important concept in your field. You are sure that your students must have thoroughly understood the material since your examples were so vivid and salient. You confidently move forward. The next week you are grading the homework assignments and you realize that 75% of the students simply did not get the basic concept. “What is wrong with the students?” you wonder in frustration, “Are they just not listening? Do they just not care?”

Scenario 2—the student’s view: I attended class today and I thought I understood everything that was covered in class. The professor’s explanation seemed so clear to me. But now that I’m home and trying to do my homework, I realize that I don’t know how to get started. Maybe it wasn’t as clear as I thought it was.

THE OPPORTUNITY:

Incorporating active learning techniques helps students process the material in class when they can still ask for guidance, taking more ownership over their learning and learning the material more deeply.

II: What is active learning?

Active learning is a learner-centered approach to teaching.

Learner-centered teaching supports students’ learning and understanding process, and gives them opportunities to use, analyze, and synthesize information based on the fundamental knowledge of the discipline. This approach to teaching is based on understanding how students learn: by actively connecting new information to prior knowledge in order to create personal meaning. The instructor plays multiple roles in this process, including sharing knowledge through lectures and assigning reading material, and guiding and facilitating learning by asking questions and structuring active learning experiences. In class, students listen, think, write, solve problems, and talk with each other and the instructor.

Contrast this with an instructor-centered approach to teaching.

In instructor-centered teaching the instructor covers the course material by presenting large chunks of factual information and detailed knowledge through lecture, elaborating on it with examples, demonstrations, etc. Students mainly listen quietly while taking notes during class. Practice for students typically takes place after class as they complete homework assignments.

In addition to a fundamental approach to teaching, active learning also refers “to a collection of teaching practices that put into practice the fundamental concept that to truly learn, we need to make an idea, a concept or a solution our own by working it into our personal knowledge and experience.” (Barkley 2010, 16).


There are hundreds of active learning strategies you can adapt for use in any discipline:

- “Active Learning Techniques” (Requires Georgia Tech login): Active Learning Techniques

For another perspective:

Watch beginning of “Confessions of a Converted Lecturer” featuring Dr. Eric Mazur, Balkanski Professor of Physics and Applied Physics at Harvard University: https://www.youtube.com/watch?v=WwslBPj8Gql

(Focus on 1:30–16:18)

Speaking of active learning, since this is an active learning workshop, it is especially important to practice what we preach! Each section will ask you to engage in at least one learning exercise to work through the core learning goal. Here is the first one:

Learning Exercise #1:

Go to any public space where you expect learning to take place. Observe any experiences that seem to facilitate learning. Are there any teachers present? What is their role?

Post about any interesting insights you gain on the T-Square discussion forum.
Three common misconceptions about active learning addressed:

- **Active learning is not anti-lecturing.**
  - Lecturing is a very good strategy for transmitting fundamental disciplinary knowledge. Lecturing is just not the only strategy that can or should be used to facilitate students’ learning process.

- **Active learning is not necessarily a physical activity.**
  - The “active” refers to the mind being actively engaged. Even if a kinesthetic strategy is used, active learning is not complete until the instructor facilitates some reflection about what students have learned from the exercise.

- **Active learning is not easier than instructor-centered forms of teaching.**
  - Active learning requires significant advance preparation by the instructor who must think carefully about what students need to learn as well as how to facilitate it. In addition, instructors new to active learning often encounter student resistance to learning in an unfamiliar way (student resistance is addressed later in this workshop). We recommend starting small with just one or two simple strategies and adding more as you become more comfortable with this approach to teaching.

Learning Exercise #2: P.M.I.

Think back to recent experiences you have had as an instructor or as a student of both learner-centered and instructor-centered classrooms. In your experiences:

- **P:** What are the pluses of each approach?
- **M:** What are the minuses of each approach?
- **I:** What do you find most interesting about each approach?

Post your responses in the discussion forum. Please also respond to any interesting points in the previous posts.

About this technique: P.M.I. is a technique to encourage students to reflect on their emerging perspectives on new concepts that you introduce in class. In a face-to-face class you might ask students to first write some notes about these questions individually, then share them with a neighbor, and then call on a few students to share their thoughts with the full class (which is another technique called Think-Pair-Share).
III: What evidence exists that active learning is effective in promoting student learning?

Hundreds of studies have investigated this question. Here are just a few:

**Experimental:**
Hake (1998) compared the pre and post test scores of introductory Physics students in traditional vs. active learning classrooms and found that students who were taught through active learning made significantly more learning gains.


Knight and Wood (2005) compared the impact on student learning outcomes of a traditionally taught vs. an interactive approach to teaching a large, upper-level, developmental biology class. They found that students made significantly higher learning gains and gained better conceptual understanding in the more interactive course.


Luckie et al (2004) found that students who participated in inquiry-based labs outscored by over 10 points their peers who participated in traditional labs on the Medical College Admission Test-style standardized exams.


**Meta-analyses:**
Prince (2004) examines the empirical evidence available for the effectiveness of the most common types of active learning used in engineering disciplines, namely active, collaborative, cooperative, and problem-based learning. The literature supports the effectiveness of all forms of active learning in improving student learning. Furthermore the findings call traditional assumptions about teaching practices in engineering into question. While different methods and implementations will have varying levels of effect, overall these approaches to active learning are effective in improving student learning.


Freeman et al (2014) completed a meta-analysis of 225 studies that focused on the effect of using active learning in STEM disciplines. They found that on average, students in traditional lecture courses are 1.5 times more likely to fail than students in courses with an active learning approach (8410).


Learning Exercise #3: What about your discipline?

Find a paper or other resource that addresses how active learning has been implemented in your own discipline. Report back to the discussion forum on what you discover. Are there any signature strategies that work particularly well in your field? Did you uncover any important criticisms for the group to consider?

More resources about active learning: The following are lists of publications and other resources about active learning to help you get started investigating its applications in your field.

Georgia Tech Teaching and Learning Resources LibGuide: http://libguides.gatech.edu/teachingandlearning

List of Active Learning Resources from the University of Minnesota: http://www3.umn.edu/ohr/teachlearn/tutorials/active/resources/index.html
IV: What active learning strategies should you use to support your learning goals?

Before you choose what learning experiences you want to engage your students with, you need to decide what it is you want them to learn. One useful framework to help you think about learning goals is Bloom’s Taxonomy (1956), which identifies six dimensions of cognitive processing ranging from lower to higher orders of thinking.

Here are basic definitions and examples of each Bloom’s level.

**Remember:** This level is related to defining concepts, teaching vocabulary, and classifying elements.
- e.g., Students identify the minerals.
- e.g., show a second-order polynomial, show them the constant and linear terms, and ask them what the quadratic term would be called. Then, students identify terms in several more problems.

**Understand:** This level is about drawing conclusions from simple problems. They select answers, make conclusions, explain concepts in their own words.
- e.g., Students describe how x-rays can be used to study minerals.
- e.g., after finding derivatives of functions, they need to comment on the meanings of the results such as there are two stationary points*.

**Apply:** This is where students take the concepts and apply them to a problem.
- e.g., Provide a wooden block model or natural crystal, and have them determine the symmetry elements that are present.
- e.g., have them solve derivation problems of increasing difficulty.

**Analyze:** This is the level at which students start relating concepts to each other. They understand how things fit together.
- e.g., Have students relate the physical properties of hardness, cleavage, and refractive index to the internal composition and structure of a mineral.
- In silicate minerals, silica tetrahedra may polymerize in different ways. Have them contrast and compare polymerization in quartz, feldspar, mica, amphibole, pyroxene, and olivine.
- e.g., show how to take a derivative of a polynomial of order 2. Then ask how the same can be done with a polynomial of order 3. Students do not just solve another problem, they have to explain how it must be done. (Structured comparison, Ambrose, p.118)

**Evaluate:** This level is about commenting, judging, and deciding.
- e.g., Explain which tool is better, optics, x-rays, or the SEM, for studying the structure and composition of a mineral.
- e.g., given a specific derivation problem, students must argue whether to use linear algebra or calculus methods to solve it. They must get to the result as well as defend their choice of method.

(continued on the next page)
Create: This is the level where they put together multiple concepts and unlock a higher level of thinking about the concept. They develop a new understanding from the synthesis of several ideas, which also creates new information for them.

- e.g., There are more than 100 elements and many possible combinations that two or more of these could be combined in minerals. Furthermore, the same combinations of elements could be combined in different structures. Despite this, there are relatively few common minerals. Why?
- e.g., show how to take a derivative of a polynomial; then ask them to represent this in a linear algebra formulation. Have them make the connection between different concepts.

Each level builds upon the other. In fact, Bloom’s Taxonomy is often represented as a pyramid (see below) to illustrate this building relationship between higher and order thinking skills. For example, in order to successfully solve problems at the application level, students need to be able to identify the type of problem and understand the conceptual principles and procedures needed to solve it.

These resources provide useful ways to visualize the relationship between the “Bloom’s Levels” and how to use them to create your own learning goals.

**Bloom’s Taxonomy from Old Dominion University:**

- Notice that the new version uses slightly different verbs and a slightly different order than the old version. The new version comes from Anderson and Krathwohl who published a revision to Bloom’s original taxonomy in 2001 that has also been widely adopted. It is good to be familiar with both since you often run into one or the other.

**“A Model of Learning Objectives” from Iowa State University:**

- This website provides a number of heuristics to help you use Bloom’s to create your learning goals and design learning exercises.

**“Bloom’s Verbs and Matching Assessment Types”**

- A helpful alternative way to visualize Blooms: The levels are in the center (don’t be thrown off by the use of the old categories—see first resource above), the middle layer provides verbs you can use for your learning goals, and the outer layer provides examples of exercises you can adapt for your purposes.

*Special thanks to Burak Bagdatli and Pamela Grothe for sharing examples of learning goals for each Bloom’s level.*

**Works Cited:**


**Learning Exercise #4: Write your Learning Goals**

Write one learning goal for your microteaching lesson. Share this with the discussion forum. Which level of Blooms did you decide to aim your learning goal? Why is this the best fit for your students?

Before you choose what active learning strategies you want to engage your students with, you need to decide what it is you want them to learn. Bloom’s Taxonomy is a helpful framework to help you construct your learning goals.
V: What are some examples of active learning strategies?

Once you know what you want students to learn, you can identify the appropriate strategies and learning exercises that will help them learn it.

The following videos illustrate how active learning can be used at each Bloom’s level. Watch the examples that seem to be the most relevant to your own learning goal(s).

Remember:
- Dr. Richard Felder (Chemical Engineering, NC State): http://youtu.be/sJsU6RbdisYE Focus on 1:49-4:49
  - Recall info from reading—review and quiz
- Dr. John Geanakoplos (Financial Theory, Yale) https://www.youtube.com/watch?v=T5IIQ0EoFQ&index=2&list=PLEDC55106E 0BA18FC (Start at 58:32)
  - Demo of Financial theory—the inherent intelligence of markets—Fishbowl

Understand
- Dr. Richard Felder (Chemical Engineering, NC State): http://youtu.be/sJsU6RbdisYE Focus on 5:45-8:30
  - Case study—Students work through equations and answer conceptual questions
- Dr. David Malan (Intro to Computer Science, Harvard University) http://cso.tv/2013/fall/ Focus on Introduction—>Week 0—>Videos—>12:23-18:00
  - Demo of the principle of Algorithms: students match each other and add their numbers together
- Dr. Thad Polk (Psychology, University of Michigan) http://www.crit.umich.edu/faculty/Thurnau/ThurnauVideos Video #1, Focus on 1:06-2:43
  - Example followed by reflection about a Psychology principle

Apply
- Dr. Eric Mazur (Physics, Harvard University) https://www.youtube.com/watch?v=wnzv_LzS5E Focus on 0-2:45
  - ConcepTests where students answer a multiple choice conceptual question in class.
- Dr. Denis Auroux (Math, MIT) http://ocw.mit.edu/courses/mathematic s/s8-02-multivariable-calculus-fall-2007/video-lectures/lecture-1-dot-product/ Focus on 33:18-37:00
  - Predict the answer—low tech clickers, multiple choice questions

Analyze
- Dr. Eric Mazur (Physics, Harvard University) https://www.youtube.com/watch?v=wnzv_LzS5E Focus on 2:45-end
  - Peer Instruction: The follow up to ConcepTests where students work in groups to “convince” each other as to which of the answer choices is the correct one.

Evaluate
- Dr. Michael Sandel (Justice, Harvard University)
  http://athome.harvard.edu/programs/jm r/ The whole thing is excellent, but at least watch the first couple of minutes.
  - Socratic method: the instructor uses questioning to push students to justify their arguments
- Dr. Deborah Ball (Educational Policy, University of Michigan)
  http://www.crit.umich.edu/faculty/Thurn au/ThurnauVideos Video #4, Focus on 1:06-4:15
  - Students are asked to examine some data related to an educational policy and evaluate its implementation.

Create
- Dr. Robin Wright (Biology, University of Minnesota):
  http://youtu.be/dWjy2TqgAwo Focus on 4:22-5:16
  - Inquiry: students engage in inquiry based learning to develop their own research projects which they present at the end of the semester in a poster session
- Dr. Alec Gallimore (Aerospace Engineering, University of Michigan)
  http://www.crit.umich.edu/faculty/Thu

Learning Exercise #5:
Reflect on the following questions and post some of your thoughts to the discussion form. You do not need to post about each question, but rather use the questions as a guide for your contribution(s).

- Might the example be tweaked to work at another Bloom’s level? Is it challenging students to draw on more than one level of thinking?
- What does the instructor do in this example? What do the students do?
- What kind of preparation is involved in making this approach work?
- How might you apply this strategy to your own subject?
- Did you find any additional examples that weren’t on the list? 0
Active Learning may upset student expectations about what it means to be a successful student. Be compassionate: they learned this formula over many years of study.

Start Early and Be Persistent

Although students may resist at first, if you start early (as soon as the first day of class!) and are persistent and consistent in creating these learning experiences for students, they will come around to the benefits of this approach.

VI: How can you anticipate and address student resistance to active learning?

Active Learning is sometimes an unfamiliar and uncomfortable learning experience for students who are used to the traditional lecture. It is normal for instructors to experience some push back from students, especially when first experimenting with incorporating active learning approaches in their classes. How you set up your lessons and respond to student resistance can make all the difference in helping your students have a positive learning experience.

Strategies for addressing student resistance to active learning:

- This series of 6 "scenes" dramatize common types of student resistance to active learning and ways to respond to them. Watch one or more of the videos that best addresses your concern for some ideas on how to anticipate student resistance to your classes. [http://www1.umn.edu/ohr/teachlearn/tutorials/active/scenes/index.html](http://www1.umn.edu/ohr/teachlearn/tutorials/active/scenes/index.html)
- "Managing Student Resistance" This handout identifies common types of student resistance to innovative teaching approaches and suggests ways to address them. [Managing Student Resistance](http://www1.umn.edu/ohr/teachlearn/tutorials/active/scenes/index.html)

Learning Exercise #6:

Reflect on the following questions and post some of your thoughts to the discussion form. You do not need to post about each question, but rather use the questions as a guide for your contribution(s).

- What most concerns you about trying to use active learning strategies in your class?
- How might you apply some of the advice from the resources to your context?
- Is there anything that makes your situation different from the examples in the resources?
- How might you adjust and adapt to it?
VII: What lesson will you prepare for the microteaching?

In order to participate in the microteaching, where you will get the opportunity to teach a 10 minute lesson and get feedback from a consultant-facilitator and a group of your peers, please submit your lesson plan in advance of the session. Your lesson plan should answer the following questions:

- What do you want your students to learn? At what Blooms level?
- Describe your teaching approach (strategy, etc). How well does it align with your learning goal?
- Anticipate at least one type of student resistance you are likely to experience. How will you address it?

You may submit your plan as late as your arrival to the workshop. However, if you submit it in advance by August 21, 2014, a consultant can send you some feedback before the microteaching. Please send your lesson plans to csubino@cetl.gatech.edu by August 21, 2014. Individuals who submit their lesson plans after the date may still participate in the microteaching, but will not be guaranteed early feedback. Individuals who arrive at the microteaching without completing the tutorial and lesson plan will be allowed to observe but not participate.

About this technique: This is a technique called the Entry Ticket to Class. If it is important for your students to have completed a certain exercise or amount of preparation for your class to be successful, you can require them to complete it in order to participate in the class.

FOR MORE INFORMATION

If you have any questions about the content of this workshop or process for participating in the microteaching workshop on September 4, 2014, please contact Dr. Carol Subiño Sullivan csubino@cetl.gatech.edu