UCLA CEILS
Center for Education Innovation & Learning in the Sciences

CEILS Faculty Workshop on Best Practices in Teaching 2016

Active Learning Techniques

1. **Put a check next to activities/techniques you currently or already planned to use.** (Definitions on next page.)

* Note: Many activities can fit in multiple categories. Almost all have evidence to suggest increased learning and/or retention in university science courses.

Effort ↓	**Whole Class Discussion**	**Peer Instruction (during lecture)**	**Just-in-Time Teaching (JiTT)**	**Group Work in Discussion Section**	**Homework**
Low	☐ Stop, turn, wait ☐ Wait-time (7 sec.)	☐ Think-pair-share	☐ JiTT Reading	☐ Group Work w/ self-selected groups working on homework ☐ Undergraduate learning assistants (LAs)	☐ Textbook problems
Medium	☐ Carefully plan, deliver and evaluate lectures ☐ Open questions ☐ Many hands	☐ Clickers ☐ A-B-C-D cards	☐ JiTT Quiz ☐ Computer simulations + games	☐ Group Work w/ Assigned groups ☐ Guided Worksheet ☐ Case Study or Context-rich Problem (find one)	☐ Interdisciplinary problems ☐ Quizzes on homework ☐ Concept maps ☐ Writing w/ peer review
High	☐ Call on random students (after think-pair-share) ☐ One-minute papers	☐ Guided Worksheet with embedded clicker questions ☐ Cooperative quizzes	☐ Flipped classroom ☐ JiTT interactive video or tutorial	☐ Case Study or Context-rich Problem (design one specific to the course)	☐ Problem-based learning

2. Can you identify 1-3 activities you would like to add to your next course (if so, circle these)?

3. Can you describe a plan for how you want to add these activities or techniques to your class? (Do you need to find materials? Do you need to practice a new technique?)

4. Can you describe challenges you anticipate in doing this, and how you might overcome these challenges?

Activities	Description	Examples and Resources	Research Validation*
A-B-C-D Cards (w/ peer instr.)	If instructor does not want to ask students to buy clickers and/or if instructor does not want to use clicker technology, students can simply hold up colored pieces of paper to indicate answers to multiple choice questions. Engage students in lecture classes by asking cognitively engaging multiple-choice questions to challenge their thinking and foster deep discussion. Students vote with colored cards, try to convince their neighbors, and vote again.	http://www.vaniercollege.qc.ca/pdo/files/2014/07/ABCD-Voting-Card.png	Good
Call on random students	"It is very easy for faculty to hold classroom discussion with only the students in the first few front rows (Perkins and Wieman, 2005). Some faculty draw names at random from a hat to ask specific students questions and award credit for their participation." Other faculty, to reduce anxiety, give students extra credit for agreeing to be on list of random names.	Mintzes, J. J., & Leonard, M. H. (Eds.) (2006). Handbook of college science teaching. Arlington, VA: NSTA Press.	
Carefully plan, deliver and evaluate lectures	"Good lectures convey new terms and concepts, delineate historical context, demonstrate function, and draw complex connections between ideas. Well-organized, vibrant lectures offer efficient ways to explain important detail to large groups of diverse learners. Far from one-way monologues that serve as "information dumps" from teacher to student, good lectures ground students in a topic and include activities to motivate their critical thinking about that topic." Lectures are also important in providing context to students on how the subject matter is applicable to their lives and interests.	http://cei.umn.edu/support-services/tutorials/designing-smart-lectures	Good+
Case Studies	Students draw inferences and make decisions given a detailed description of a scenario (often based on a true story).	http://sciencecases.lib.buffalo.edu/cs/	
Clickers (with peer instruction)	Hand-held electronic devices can allow students to anonymously vote on answers to multiple-choice questions in real time. Clickers are usually most effective when used with peer instruction. The recommended method is to first poll students, then ask them to discuss with neighbors if below a threshold correctness level, and then re-poll. Instructor can then ask students to explain answers.	http://www.cwsei.ubc.ca/resources/clickers.htm https://www.youtube.com/watch?v=4IAETaVXPFw Vickrey, T. et al., "Implementation of Peer Instruction: A Lit. Review" (2015).CBE - Life Sciences Education. Vol. 14, 1–11.	Very Good
Computer Simulations and Games	Students use interactive computer simulations or online games to visualize phenomena, test predictions, and receive prompt, targeted feedback to refine their intuitions and conduct and analyze virtual experiments. These can be assigned before class to get students playing with concepts and ideas before formally learning about them.	http://fold.it/portal/info/science http://phet.colorado.edu/	Good
Concept Mapping	Students create a visual representation (similar to a flow chart) that identifies and shows the interconnections among various ideas related to a specific topic or problem.	http://serc.carleton.edu/introgeo/assessment/conceptmaps.html	

Context Rich Problems	Context-rich problems are short realistic scenarios giving the students a plausible motivation for solving the problem. The problem is a short story (beginning with "you") in which the major character is the student. Context-rich problems may include excess information or require the student to recall important background information.	http://serc.carleton.edu/sp/library/context_rich/index.html	Good
Cooperative Quizzes	Students first take a quiz individually and then retake the quiz with a group. Assigning a grade to peer discussion helps further incentivize it, while making the quiz a learning experience.	http://pubs.acs.org/doi/abs/10.1021/ed072p162 https://teach.its.uiowa.edu/sites/teach.its.uiowa.edu/files/docs/docs/Instructions__Regarding_Cooperative_Quizzes_0_ed.pdf	Fair+
Flipped Classroom	The flipped classroom is a pedagogical model in which the typical lecture and homework elements of a course are reversed. This allows more in-class time for students to work together to solve problems and tackle difficult concepts.	http://net.educause.edu/ir/library/pdf/eli7081.pdf http://ed.ted.com/ http://www.khanacademy.org/	Good+
Group Work	Structure classes around small groups that work together, ideally in such a way that each group member's success is dependent on the group's success. There are different kinds of groups for different situations, but all lead to learning that differs from competitive or individualistic learning. ASSIGNED GROUPS: Studies find that students in assigned groups benefit most, particularly with mixed ability levels, and with either zero or at least two students from any traditionally under-represented groups.	http://serc.carleton.edu/sp/library/cooperative/index.html Heller, Patricia et al. "Teaching problem solving through cooperative grouping." MAA NOTES (1997): 159-172. http://info.catme.org/ (to automatically assign groups)	Very Good+
Guided Worksheet	Many validated worksheets have been developed for large introductory courses, where each component of the worksheet has been designed to maximize student learning (e.g. Interactive Lecture Demonstrations, or McDermott's Introductory Physics Tutorials). Instructors can also design worksheets that guide students through applying a concept or solving a problem. EMBEDDED CLICKER QUESTIONS: One way to maximize student participation in a large lecture is to have students work with partners during class, clicking in answers along the way. This tells the instructor where guidance is most needed.	https://www.physport.org/methods/method.cfm?G=Tutorials_in_Introductory_Physics Manjula D. et al. (2010). Use of interactive lecture demonstrations: A ten year study. Phys. Rev. ST Phys. Educ. Res. 6, 020119.	Very Good
Just-in-Time Teaching: Reading/ Quiz/ Interactive	READING: Students are given specific reading assignment before class. Instructors should list specific definitions or equations that they will assume students already know from the reading. QUIZ: Ideal Just-in-Time Teaching (JiTT) focuses on improving student learning through the use of brief web-based questions delivered before a class meeting. Students' responses are reviewed by the instructor before class and used to develop classroom activities addressing learning gaps. INTERACTIVE: This JiTT implementation allows students who already understand the pre-lecture material to move through it quickly, while those who need more remedial material have access to additional information or exercises.	http://serc.carleton.edu/sp/library/justintime/index.html CCLE has resources available to create these quizzes	Good
Many Hands	Wait for multiple hands to be raised before calling on someone. This encourages more than just the same few students to have time to think about and respond to questions.		

One-Minute Papers	Given an open-ended question, students spend one minute writing their answers on index cards, which are collected by the instructor. The question can ask students what was the most important concept they learned or what remains unclear. In large lectures, you can just check for completion and respond to some in detail the next day.	http://serc.carleton.edu/NAGTWorkshops/assess/activities/streepey.html	Good+
Open Questions	Open questions ask students to craft explanations, state relationships, evaluate an idea, or apply a concept to a new setting. Stems for open questions that encourage learning include: What did you observe?, What do you think happened? How do we know?, How does this compare to...? Best combined with One-Minute Papers or Think-Pair-Share.	Mintzes, J. J., & Leonard, M. H. (Eds.) (2006). Handbook of college science teaching. Arlington, VA: NSTA Press.	
Problem-Based Learning	Students work in groups to solve complex, multifaceted and realistic problems, researching and learning necessary background material as needed.	http://cei.umn.edu/support-services/tutorials/surviving-group-projects http://www.pbl.uci.edu/whatispbl.html	Good
Quizzes on Homework	Many students do homework quickly or mindlessly and forget what they've done. Weekly homework quizzes encourage students to put content into longer-term memory, while helping students identify concepts they may need to review further before the exam.		
Stop, Turn, Wait	When you find yourself spending a long time writing on the board, add a reminder in your notes to periodically stop writing, turn around, and wait (either for students to catch up or ask questions).	Ruhl, K. L., C. A. Hughes, and P.J. Schloss. 1987. Using the pause procedure to enhance lecture recall. Teacher Education and Special Education 10: 14–18.	
Team-Based Learning	"Team-Based Learning is an evidence based collaborative learning teaching strategy designed around units of instruction, known as "modules," that are taught in a three-step cycle: preparation, in-class readiness assurance testing, and application-focused exercise."	http://www.teambasedlearning.org/	Good+
Think-Pair-Share	Students think about the answer to a question posed by the instructor, and then discuss the question among each other. The instructor circulates during discussion, then selects students to explain the consensus to the class.	https://www.brown.edu/about/administration/sheridan-center/teaching-learning/effective-classroom-practices/think-pair-share	Excellent+
Undergrad. Learning Assistants (LAs)	LAs are undergraduate students prepared to provide support for student learning in interactive classroom environments. Primarily used in group work, LAs are specifically prepared to facilitate group conversations and conceptual understanding. LAs are chosen from the top students who took the course in previous semesters and receive credit for their assistance. +UCLA already has an LA program, so instructor need only commit to weekly planning meetings.	http://serc.carleton.edu/sp/library/learning_assistants/index.html https://www.learningassistantalliance.org/	Very Good+
Wait Time	After asking a question from any group of students, wait at least 7 seconds before calling on someone to answer. This encourages increased processing time and participation.	Fuller, R., S. et al. 1985. Developing student confidence in physics. College Park, MD: American Association of Physics Teachers.	
Writing with Peer Review	Students evaluate each other's writing using a rubric or criteria provided by the instructor.	CCLE has "Workshop" tool for this http://wac.colostate.edu/journal/vol3/chisholm1.pdf	

* Very rough indication of research validation based on www.physport.org evaluation of research validation for physics application (see next page). Blank means no indication given on PhysPort.
+ Indicates CEILS staff assessment of supporting research.

Research Validation Ranking (for techniques applied to Physics): www.physport.org

Gold star > Silver > Bronze > Research-based