ENGAGING STUDENTS IN LEARNING IN LARGE CLASSES

Putting research on learning to practical use

Carol Ormand
SERC, Carleton College
AGU, Fall 2012

Challenges: Engagement

Quotes from the pre-workshop survey:

- How to make a 300 person class more interactive and alive.
- I'd like to address how to engage students during my time with them to promote deep understanding of concepts.
- How to get my students to increase their problem solving and higher order thinking skills.
- Balancing conceptual knowledge and content with skills/methods/ approaches to solving problems especially quantitative skills.
- How to give students in a large class setting the opportunity to interact and participate in lecture learning the way a small class setting allows for.
- Teaching students with diverse backgrounds. How do I equilibrate to a common standard that is above that of the weakest student? Example: Engineers may find the quantitative content of my lecture primitive while geographers will struggle with equations and concepts.

Research-based Keys to Success

- Use active learning pedagogies, such as
  - Interactive lectures (e.g. think-pair-share, ConcepTests, interactive demonstrations, lecture tutorials, Just in Time Teaching)
  - Cooperative learning (e.g. jigsaws, peer teaching, cooperative exams)
  - Flipped classrooms
- Provide formative feedback, early and often

Image from http://serc.carleton.edu/sp/library/classresponse/how.html

Engaging Students in Learning

"What is often called 'deep learning,' the kind that demands both understanding and remembering of relationships, causes, effects and implications for new or different situations simply *cannot be made easy*. Such learning depends on students actually *restructuring* their brains and that demands effort." (Leamnson, 2002, p.7).

How can we engage our students in deep learning?
Pose questions and problems for them to solve.
This can take many forms:

- Interactive lectures
  - Think-pair-share
  - ConcepTests
  - Interactive demonstrations
  - Lecture tutorials
  - Just-in-Time Teaching (JiTT)
- Cooperative/collaborative learning
  - Jigsaws
  - Peer teaching
  - Cooperative exams
- Studio teaching
- Flipped classrooms

Engaging Students in Learning

Quick polls:

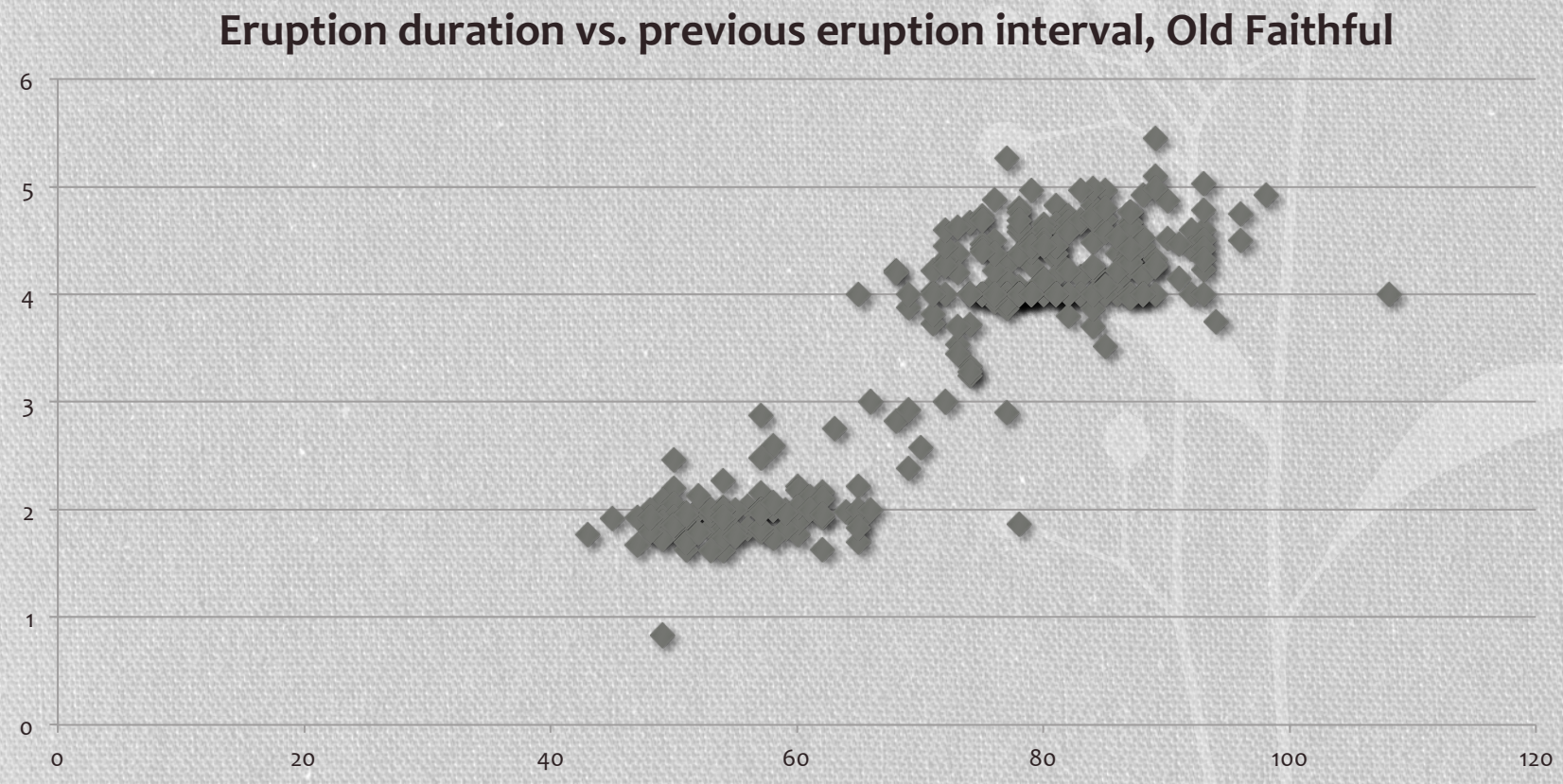
1. How many of you use one or more of the methods mentioned below?
   - Think-pair-share
   - ConcepTests (aka “clicker questions”)
   - Interactive demonstrations
   - Lecture tutorials
   - Just-in-Time Teaching (JiTT)
   - Jigsaws
   - Peer teaching
   - Cooperative exams
2. How many of you have tried one or more of those methods and discontinued them?
3. How many of you worry that making your lecture more interactive requires teaching less content?

Engaging Students in Learning

Interactive lectures (e.g. Mazur, 1997; Hake, 1998; McConnell et al. 2006)

- **Think-pair-share**: pose a question; have students think about it (individually); have students discuss their answers with a neighbor; ask the class to share their thoughts

What does this graph tell us about the eruption behavior of Old Faithful geyser?



Engaging Students in Learning

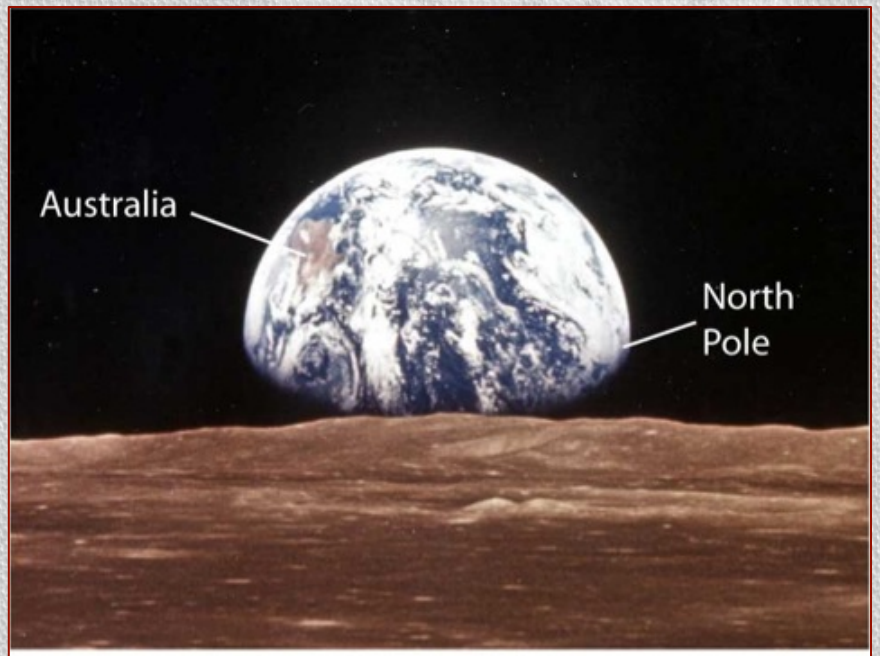
Think-pair-share: What are some of the barriers that prevent you from incorporating (more) interactivity in your large classes?

Answers:

Engaging Students in Learning

Interactive lectures

- **ConcepTests (clicker questions)** (e.g. Mazur, 1997; McConnell et al. 2006): Follow a lecture segment with a conceptual test question to see whether students "got it."



Earth, as seen from the Apollo 11 Lunar Lander, Sea of Tranquility, July 19, 1969

What was the phase of the moon, as seen from Earth?
A. Full
B. New
C. Quarter
D. Crescent
E. Gibbous

Was the moon waxing or waning?
A. Waxing
B. Waning

Engaging Students in Learning

Interactive lectures

- **Interactive demonstrations** (e.g. Couch et al., 2004): Student predict, experience, and then reflect.

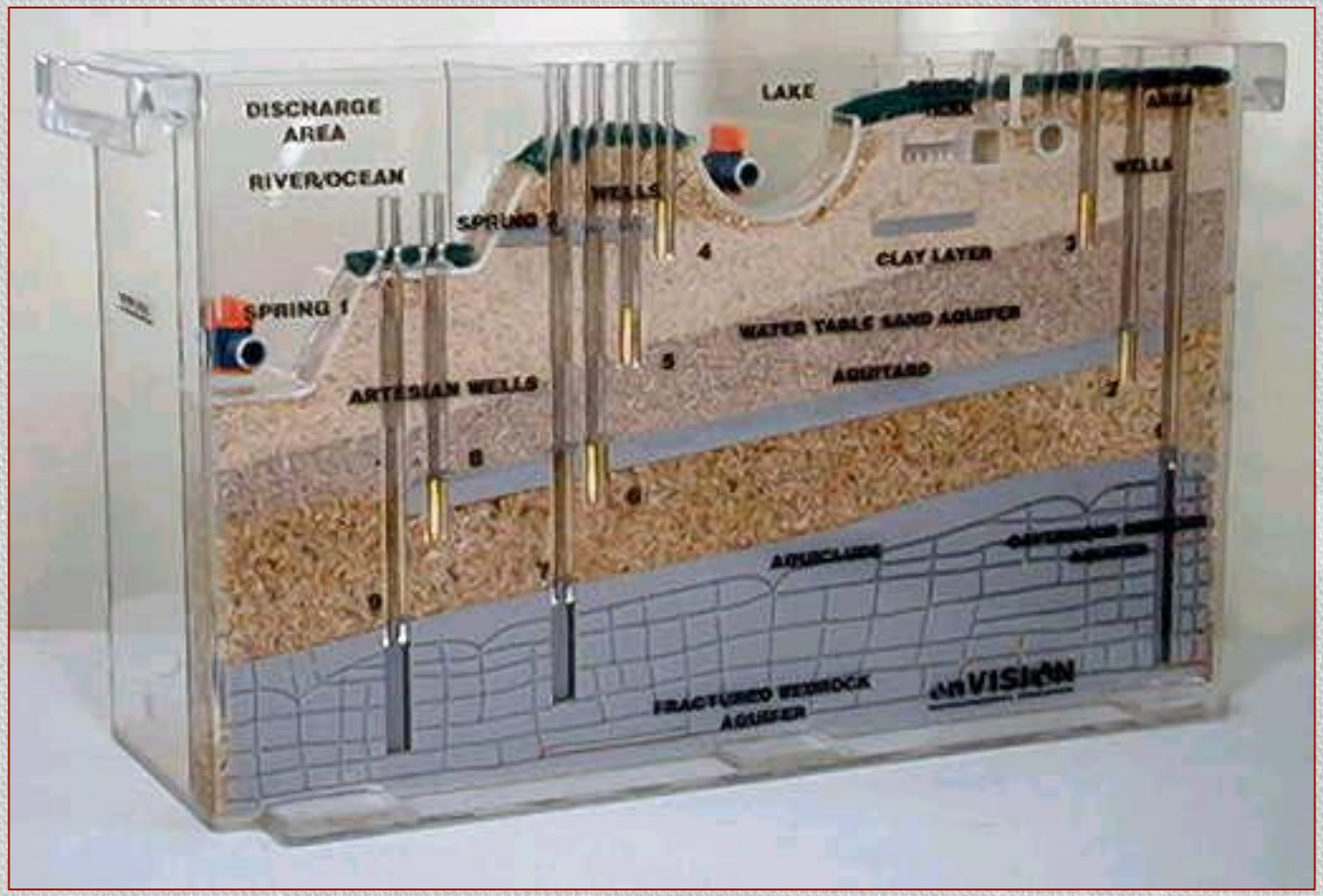


Image from http://www.coshoctoncounty.net/agency/swcd/educationinformation.php

Engaging Students in Learning

Interactive lectures

- **Lecture tutorials** (Kortz, Smay, and Murray, 2008): Follow a lecture segment with a worksheet of conceptual questions that students can answer independently or in small groups.
- Walk around the classroom helping students who are stuck. Where that is impractical (because of the classroom set up), encourage students to ask their neighbors for help when stuck.
- Review key points when students have finished the tutorial.

Image from http://serc.carleton.edu/sp/library/lecture_tutorials/index.html

Engaging Students in Learning

Interactive lectures

- **Just-in-Time Teaching (JiTT)** (Simkins and Maier, 2010): Students answer online questions, with answers due a few hours before class. The instructor reviews students' responses prior to class and addresses topics or concepts that students struggled with during lecture. If warranted, an in-class activity may be devised to help students grasp the concept.

For an environmental science class, after students complete a reading assignment:

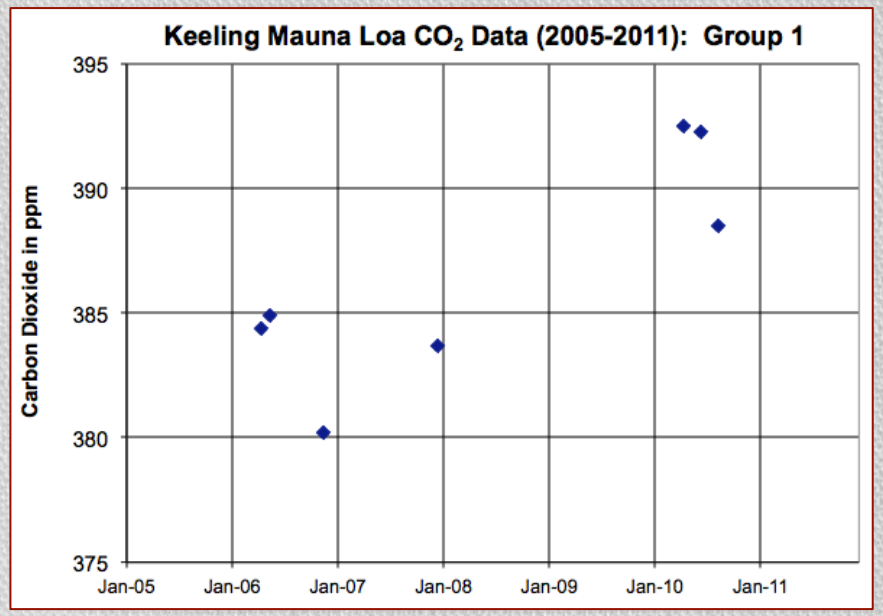
What are some of the biological effects of dam removal (good and bad)?

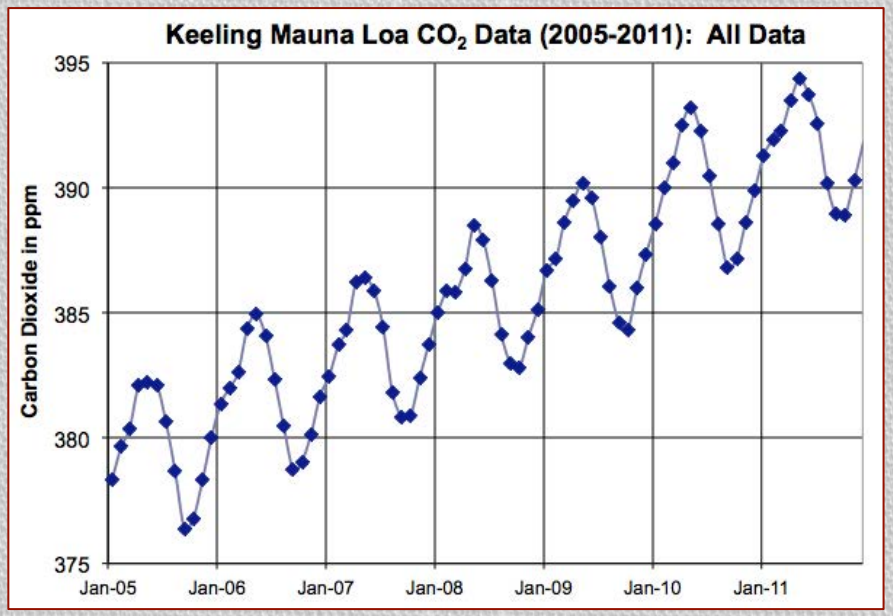
Image from http://commons.wikimedia.org/wiki/File:Three_Gorges_Dam_09(2).jpg

Engaging Students in Learning

Cooperative/collaborative learning: Randy's Mauna Loa CO_2 exercise (http://serc.carleton.edu/introgeo/interactive/examples/co2.html)

1. Each group of ~4 students graphs a handful of data points (CO_2 levels vs. dates) and makes predictions based on them:
   - Draw a line through your data; predict when CO_2 will be twice its original value.
2. Show students what the graph looks like when you use all of the available data.
3. Ask students why their predictions varied (from group to group) so much.
4. Give a brief lecture on interannual and intrannual CO_2 variation.





Resources

Teaching large classes:

- http://serc.carleton.edu/teachearth/site_guides/largeclass.html
  - http://serc.carleton.edu/NAGTWorkshops/intro/large_classes.html
  - http://serc.carleton.edu/NAGTWorkshops/earlycareer/teaching/LargeClasses.html

Motivating students:

- http://serc.carleton.edu/NAGTWorkshops/intro/motivation.html
- http://serc.carleton.edu/NAGTWorkshops/metacognition/largeclasses.html

Engaging students in learning:

- http://serc.carleton.edu/sp/library/interactive/index.html
- http://serc.carleton.edu/sp/library/cooperative/index.html
- And many more, here: http://serc.carleton.edu/sp/library/pedagogies.html

Assessment in large classes:

- http://serc.carleton.edu/NAGTWorkshops/assess/lgclass.html

References

- Couch, Catherine, Adam P. Fagen, J. Paul Callan, and Eric Mazur (2004). Classroom demonstrations: Learning tools or entertainment? *American Journal of Physics, v.* 72, n. 6, pp. 835-838.
- Hake, R. (1998). Interactive-engagement versus traditional methods: A six-thousand-student survey of mechanics test data for introductory physics courses. American Journal of Physics, v. 66, pp. 64-74.
- Kortz, Smay, and Murray (2008). Increasing student learning in introductory geoscience courses using Lecture Tutorials. Journal of Geoscience Education, v. 56, pp. 280-290.
- Leamnson, R. (2002). Learning (Your first job). Retrieved January 18, 2010, from http://www.ctl.uga.edu/Learning/.
- Mazur, E. (1997). Peer instruction: A user's manual. Prentice Hall, 253 pp.
- McConnell, D.A., Steer, D.N., Owens, K.D., Knott, J.R., Van Horn, S., Borowski, W., Dick, J., Foos, A., Malone, M. McGrew, H., Greer, L, and Heaney, P. J. (2006). Using conceptests to assess and improve student conceptual understanding in introductory geoscience courses. Journal of Geoscience Education, v. 54, pp. 61-68.
- Simkins, Scott and Maier, Mark (Eds.) (2010). Just in Time Teaching: Across the Disciplines, Across the Academy. Stylus Publishing, 224 pp.