Concept tests and Peer Instruction: A Simple Way to Assess Teaching and Learning in Geoscience Courses

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What are Concept Tests?
Concept tests are higher-order multiple-choice questions that focus on one key concept of an instructor’s major learning goals for a lesson.

When coupled with student interaction through peer instruction, concept tests represent a rapid method of formative assessment of student understanding, require minimal changes to the instructional environment and introduce many of the recognized principles of effective teaching that enhance student learning.

Example Questions and Student Responses
(Numbers in parentheses indicate % of students selecting the answer before/after instruction)

Question asked in Environmental Geology:
Which layer is the oldest in the image shown below?

- a) Lower (42% vs. 7%)
- b) Layer 2 (16% vs. 9%)
- c) Layer 3 (48% vs. 45%)
- d) None of the above

Question answered in Environmental Geology:
What is the relative displacement shown in the photo?

- a) Left lateral (20% vs. 8%)
- b) Right lateral (5% vs. 96%)
- c) Normal (13% vs. 95%)
- d) Reverse (74% vs. 74%)

Question asked in Environmental Geology:
Which rock is most likely associated with the event shown in the diagram below?

- a) Andesite (42% vs. 35%)
- b) Gabbro (7% vs. 74%)
- c) Basalt (16% vs. 35%)
- d) Obsidian (42% vs. 27%)

From the Student Viewpoint...
Three-quarters or more of students in courses taught by instructors who introduced concept tests in lectures at Pennsylvania State University and Washington and Lee University found this teaching method helped them better gauge the level of conceptual understanding.

From the Instructor Viewpoint...
The overall reaction of the students to concept tests is one of excitement. Questions are taken seriously. Flash cards are handed out... students pay close attention to the lecture in anticipation of when the concept test question will pop-up.

The class fully participates in the exercise. I have seen no hesitation in students raising their hands... Students carefully think about their answers and write down rationales in defending their choices. Students often crave to know the answers... they want to discuss the answer after the exercise. I sense more energy in the class.

I think is has tremendous impact. I could see that the student enjoyed interacting with one another; sometimes there were heated discussions going on.

Comparison of difference in improvement in score on Geosciences Concepts Inventory (GCI) between pre- and post-tests at three institutions from this study using concept tests (green bars) and 25 institutions (yellow bars) where instructors utilized a variety of teaching methods. Red indicates control class taught without using concept tests at one of the three institutions piloting the use of concept tests. Note that improvements on GCI in the concept classes ranked in the upper third of all classes taught.

Why this Works:
Good Teaching Practices Applied (Chickering and Gamson, 1987)

1. Encourage student-faculty contact - Faculty have opportunity to interact with students as he moves around the classroom.
2. Encourage cooperation among students - Students talk to one another during peer instruction portion.
3. Encourage active learning - Students actively participate in their learning during class which promotes metacognition.
4. Give prompt feedback - These formative assessments are used immediately following the introduction of key concepts.
5. Emphasize time on task - Well-conceived concept tests focus student attention on critical concepts rather than basic facts.
6. Communicate high expectations - The integration of concept tests into lecture sets higher expectations for student performance.
7. Respect diverse talents and ways of learning - Peer instruction on concept tests teaches some students how to think critically, and allows others to explore their depth of understanding.

Where can you find these questions and the pedagogy to use them?

http://science.carleton.edu/introgeo/interactive/concept.html

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