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Pre-tests Improve Students' Critical Thinking

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Pre-tests Improve Students' Critical Thinking

The practice and the need it addresses

Pre-tests at Beginning of Class

First-year students' critical thinking and analysis in science is rudimentary in SCI 101, the College of Sciences First Year Seminar. I tested whether the use of Pre-tests (Figures 1 and 2) can improve students' inquiry, critical thinking, and analysis skills.

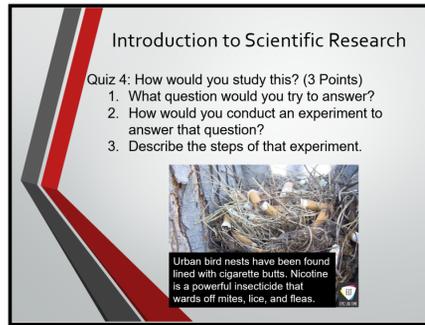
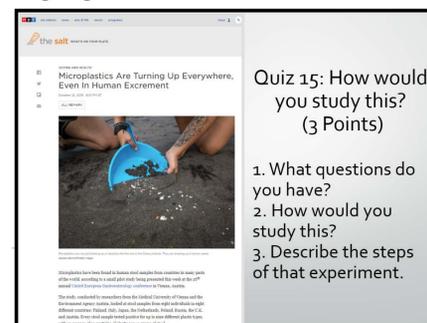


Figure 1. Example "Cigarettes in Bird Nests" Pre-test given at the beginning of the semester.

In the first 5 minutes of each class, I project 1-3 questions that address the prior lesson or the current day's lesson. These low-stakes (2-3 point) graded quizzes help students recall information from past lectures, practice using those skills and knowledge, focus on what they still need to know, and get ready to learn for that day's lecture. As a result, students are also more likely to come to class, be on time, take notes on paper, and be actively engaged in class.

Figure 2. Example "Microplastics in Human Excrement" Pre-test given at the end of the semester.



Evidence this practice benefits UNLV Students

Improved Grades, Attendance, and Critical Thinking Scores

- Pre-tests evaluated using a 1-6 point rubric based on Bloom's Taxonomy.
- Average scores increased from 2.97 (Beginning of Semester) to 4.78 (End of Semester) (n = 87).
- By the semester's end, 55% of students created new research questions and experiments rather than simply analyzing problems (Figure 3).

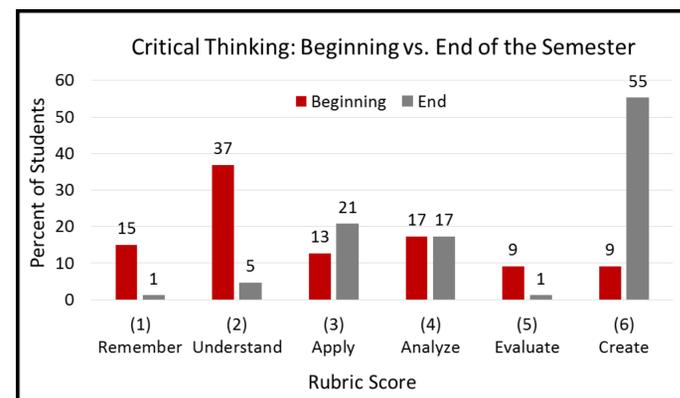


Figure 3. Pre-test score results at the beginning and end of the semester show students' improvement in critical thinking.

Comparison of Impact of Pre-test Implementation:

- Class attendance improved 3.5% (Fall 2017 vs. Fall 2018).
- Scores on semester-long Research Posters improved 8.1% (Fall 2017 vs. Fall 2018).
- Overall course grades improved 3.6% (Fall 2017 vs. Fall 2018).

Resources and where to find them

Pre-tests, ConcepTests, and Minute Papers

- Use the first 5 minutes of class to capture students' attention, prepare them for learning, examine prior knowledge, or review material from last time:
 - Lang, J. (2016). Small changes in teaching: The first 5 minutes of class. *The Chronicle of Higher Education*. Retrieved from: <https://www.chronicle.com/article/Small-Changes-in-Teaching-The/234869?cid=cp44>
- A collection of ConcepTests that can be used with clickers:
 - CCWSEI. (2018). Clicker question collections (aka "ConcepTests"). *Carl Wieman Science Education Initiative at the University of British Columbia*. Retrieved from: <http://www.cwsei.ubc.ca/resource/clickers.htm#questions>
- Minute papers or questions at the beginning or end of class enhance students' learning:
 - Angelo, T.A. & Cross, P.A. (1993). *Classroom assessment techniques: A handbook for college teachers* (2nd ed.). San Francisco: Jossey-Bass.

How other UNLV teachers might adopt this practice

Simple Pre-test Format

1. Try a basic 2-question structure for your Pre-test slide at the beginning of each class:
 - A question about an important concept from the last class meeting;
 - A question about a concept that you will focus on in this class meeting; and/or
 - A concept that tends to confuse students that will raise their awareness of what you are about to teach them.
 2. Project the slide so students see it as they arrive and settle in.
 3. Set a timer; when time is up, collect the papers. If students do not get started, play on their phones, or are late to class, they miss the points.
- Additional Tips:
- Pre-tests require significant additional time (2-3 minutes per student) on the instructor's part to grade.
 - The time spent grading is valuable feedback both to you as an instructor and to your students. It enables you to "Close the Loop" and make immediate (next class) adjustments to your course content rather than waiting weeks or months to make instructional changes.
 - Because students already have paper out, they are more likely to take notes, especially since they know they may need the information for the next Pre-test.