Using Pre-tests and Post-tests to Measure Student Learning

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Measuring Learning

- Given: We teach so that students learn the content, not to generate salary, not for entertainment, not for appearances.
- Current measure = exams (post-tests)
- Ignores previous knowledge: pre-test score is the best predictor of post-test score (Fig. 1)
- Add pre-tests to examine the change in student understanding.
- Measuring gains may help instructor morale!
- In both cases, consider test validity and timing.
- Align test items, course objectives, and content.

Administration Pre-tests & Post-tests

- Usually, same questions on both pre-test and post-test
- Balanced pre- post-: half of the class pre-tests on form A & post-tests on form B, other half pre-tests on form B and post-tests on form B – requires 2 questions for each testable concept
- Pre-test: 1st day of class, before content delivery starts
- Make sure to do item analysis early in the term so you can respond to the results.
- Post-test: on day of final exam (or after)
- Grade, include on final for full or extra-credit
- Wait to assess long-term understanding, not short-term memorization.

Analyzing the Results

- Comparing pre- and post-scores
  - Plot one against the other (Fig. 1)
  - Paired t-tests – built into recent versions of Excel: test(pre-scores, post-scores, 1,1)
  - Calculating normalized gain: \(<g> = \frac{(post-test - pre-test)}{(max. score - pre-test)}\) (Hake, 1998)
  - Students with high pre-test scores have less room to improve statistically.
  - Accounts for “headroom” on test.
  - For example, in the situation below, both groups have the same \(<g>\) even though freshmen have a higher raw gain:

Looking for patterns to improve teaching

- Misconceptions – wrong answers the students choose frequently; do they persist after instruction?
- Student preparedness: does pre-test score affect gain?
- Class/group size: Does it affect learning gain?

Choosing or Designing Tests

- Want wide score distribution on pre- and post-test
- Existing concept inventories
  - Multiple choice: useful for large classes
  - Often composed of validated questions
  - Recommended combinations of questions have been tested for reliability, may be standardized
- Instructor-designed tests (you already write exams!)
- Keep it short – only a few questions (<30 minutes)
- Smaller classes: consider open-ended formats
- Avoid terminology so you can measure concept change.
- Tests for skills and attitudes are possible.

Using the Results

- Building student groups
  - Heterogeneous for diversity/cooperation
  - Homogeneous for differentiated instruction
  - Planning lectures and activities
  - Addressing misconceptions & gaps in understanding
  - What won’t work
    - Comparing instructors: class size, student prior knowledge, etc. matter too much
  - Comparing classes that took different tests
- Attempt to measure effects of curriculum change
  - In Fig. 3, course was redesigned & new format used from ’07 on, but no significant difference in normalized test gain

References