What is Teacher Effectiveness and How May it Be Assessed?

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Outline

- Goals
  - Non-subject-specific
  - Science Process
  - Science Content
- Assessment Measures
  - Direct measures *[assessment of teacher's students]*
  - Indirect measures *[assessment of in-service teachers]*
  - Pre-service measures

Effective at doing what? Teachers have many goals…

- Non-subject-specific learning goals
- Science process skills
- Science attitudes
- Science content knowledge

Goals

- Non-subject-specific learning goals
  - *Functioning:* sustained, persistent on-task effort
  - *Reasoning:* observation, classification, correlation
  - *Attitudes:* interest, enjoyment, and perseverance
  - *Process:* productive questioning, thoughtful investigation
- Science process skills
  - Control experiment, test conclusions and reproducibility
- Science attitudes
  - Interest, enjoyment, and perseverance in science learning
- Science content knowledge
  - Understanding of concepts and unifying principles, ability to apply in solving problems and applying to real contexts

Weighting of learning goals as function of grade

Different grade levels have emphases on different goals:

- *lower grades:* more emphasis on general learning and process skills
- *upper grades:* more emphasis on specific science concepts

Assessment Measures

- Direct Measures
  - assessment of learning gains made by teacher's students
- Indirect measures
  - observations of teacher's classroom functioning and pedagogical style
- Pre-service measures
  - assessments of knowledge, skills, and attitudes of teachers in training

Direct Measures

Assessment of Learning Gains Made by Teacher's Students

- Students' non-subject-specific learning skills
  - Qualitative observations + ?
- Students' science attitudes
  - Attitude surveys, e.g., MPEX and CLASS
- Students' science process skills
  - Qualitative observations and rubrics to assess skills with experiment design, execution, and analysis
- Students' science conceptual knowledge
  - Multiple-choice and free-response written diagnostics, interviews

Indirect Measures

Observations of teacher's classroom functioning

- Classroom management
  - are students on-task and engaged?
- Planning and implementation
  - Are instructional goals and plan specified?
  - Is there evidence for effectiveness of materials used?
- Instructor engagement with students
  - Do students use inductive and deductive reasoning strategies?
  - Does instructor use inquiry-based questioning strategies?
  - Assess with rubrics (e.g. RTOP) and qualitative observations by experienced instructors

Preservice Measures

Knowledge and Skills of Teachers in Training

- Knowledge of physics concepts
- Knowledge of science process skills
- Knowledge of “Nature of Science” (practices and philosophies of scientific community),
- Pedagogical content knowledge (knowledge of and interest in issues related to teaching and learning of specific concepts)
- Ability to implement effective methods and guide student inquiry

Assessment of Knowledge of Physics Concepts

- *First approximation:* scores on licensing exams such as PRAXIS and/or state exams.
- *Second approximation:* pre- and post-tests (multiple-choice and/or free-response), using standardized diagnostics such as FCI, FMCE, CSEM, and University of Washington tutorial-style questions.
- *Third approximation:* "Think-aloud" problem-solving interviews with students; analysis of students' written materials, and observations of student-teachers' practice-teaching performance.

Assessment of Science Process Skills

- Scoring rubrics such as those reported by the Rutgers group (E. Etkina et al.) and by L. Tashiro (CSU Sacramento).

Assessment of Knowledge of Nature of Science

- Instruments such as CLASS, VASS, MPEX, EBAPS, etc.
- Pre- and post-instruction data in the literature offer benchmarks for comparison.

Assessment of Pedagogical Content Knowledge

"*Pedagogical Content Knowledge*" (PCK):

Awareness of, interest in, and detailed knowledge of learning difficulties and instructional strategies related to teaching *specific* science concepts, including appropriate assessment tools and curricular materials.

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Assessment of Pedagogical Content Knowledge

- No currently accepted, standard physics-PCK instruments exist;
- Those under development (e.g. by SPU, UMaine, and CU) incorporate analysis of student-teachers' interpretations of problem responses or of discussions offered by hypothetical students
- Documentation (not assessment) of PCK by Monash (Australia) group (Loughran, Mulhall, and Berry, JRST, 2004)

Ability to Guide Inquiry

- Qualitative observations
- Rubrics such as RTOP, FASCI