Assessment and Learning

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Organization of the Short Course

- Agenda
- Logistics
- Wiki
Setting the Stage

Recommendations from national reports on the state of STEM education in higher education institutions.

- Development of new content and curriculum
- Implementation of more effective pedagogy and assessment
- Focus on student skills as important learning outcomes
- Improving of scientific literacy in citizens, and
- The potential of information technology (IT) to support learning

http://naples.cc.sunysb.edu/Pres/boyer.nsf/
Higher Education Reform Requires

University teaching is one of the few social activities that has not fundamentally changed.

Reform requires

- Infrastructure & tools
- New teaching practices focused on learning
- Removal of barriers that limit faculty participation in the reform effort

Calls to Engage Scientists & Engineers

- Efforts to reform secondary and tertiary science education often call for scientists’ participation
- Supported by major funding agencies: NSF, NIH, HHMI
- Most models describe roles for scientists that
  - Have limited systemic impact
  - Rarely create synergy between the science research and education

*Nature, 13 December 2001*
Dissatisfaction Leading to Change

“When I started as a teacher, my students, my administrators thought that I was doing a very admirable job. And as long as I asked questions I had trained the students to do, they did fine. But if I snuck up on them just slightly and went for some depth of understanding, then they were in trouble. And that bothered me.”

Teaching in the Fiji Islands as a Peace Corps Volunteer


Tenure Opened New Avenues for My Professional Career

What should be the nature of the education-research continuum in academic life?

- AGI-IDIG, University of South Carolina, Columbia, SC (1998)
- Member, NSF DUE CCLI Review Panel (1999)
- TAMU Tenure & Promotion Committee (circa 2001)

Number One Quote from the 1998 IDIG
“No, it is even more insidious than that....”
First Activity: Why are you here?

Group discussion

Overview of Assessment
Assessment of Learning

“Assessment is the ongoing process of establishing

- clear, measurable expected outcomes of student learning,
- ensuring that students have sufficient opportunities to achieve those outcomes,
- systematically gathering, analyzing, and interpreting evidence to determine how well students learning matches the expectations and
- using the resulting information to understand and IMPROVE student learning.”


Choosing Assessment Methods

- What is purpose of assessment?
  - Formative
  - Summative
- Does assessment align with learning goals?
- How will assessment show:
  - What students have learned?
  - That students have progressed?
- Will multiple assessment forms be used?
Steps in Assessment Design

- Clearly state purpose for assessment:
  - Content goals (whether & how much)
  - Process goals (diagnose, plan)
- Define what to assess:
  - Cognitive skills
  - Social & affective skills
  - Metacognitive skills – reflect, evaluate
  - Problems solving skills
  - Concepts & principles to be able to apply
  - Knowledge transfer
- Match assessment method to achievement purpose above

- Match tasks to intended learning outcomes
  - Outcomes to be measured
  - Assessment administration process
  - Actual question(s)/problem/prompt
  - Scoring
- Specify criteria for judging student performance
- Develop reliable rating process, train raters
- Use test results to refine assessments

NCREL. nd. Select or design assessments that elicit established outcomes.
http://www.ncrel.org/sdrs/areas/issues/methods/assment/as7seele2.htm
Educational assessment rests on three pillars:

- model of how students represent knowledge and develop competence in the subject domain
- tasks or situations that allow one to observe students' performance
- interpretation method for drawing inferences from the performance evidence

(Pellegrino et al., 2001)

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3 Ps: Understanding the Nature of Learning

**Psychology - Learning**
Cognitive Science, Information-processing, Social psychology, Activity theory

**Philosophy - Knowledge**
Epistemology; Science Studies; Models, Argumentation; \{ETHICS\}

**Pedagogy – Teaching Practice**
Inquiry Learning; Problem-based Learning; Community of Learners; Model-based Learning; Design Principles, Preparation for Future Learning
History of Thinking about Human Mind

- Differential Perspective
  - Individual, Mental Tests separate from academic learning - selecting and sorting
- Behavioral Perspective
  - Stimulus/Response Associations - rewarding and punishing
- Cognitive Perspective
  - Prior Knowledge, expert/novice, metacognition (thinking about thinking and knowing)
- Situative Perspective
  - Sociocultural, language, tools, discourse

Psychology & Education

Structured Knowledge
Prior Knowledge
Metacognition
Procedural Knowledge in Meaningful Contexts
Social participation and cognition
Holistic Situation for Learning:
Make Thinking Overt
  (Glaser, 1994)
Types of Knowledge

- Declarative (what);
- Procedural (how);
- Schematic (why);
- Strategic (where, when)
- Conceptual, Epistemic, Communicative or Social
- Bloom’s Taxonomy
  - Knowledge, comprehension, application, analysis, synthesis, evaluation

Nature of Science

- Science is about testing hypotheses and reasoning deductively from experiments
  - Hypothetico/Deductive Science

- Science is Theory building and revision
  - Contexts of Generation and Justification

- Science is Model building and revision
  - Models stand between Experiment and Theory
Performances - Practices

- **Piano**
  - Finger/hand strength and flexibility
  - Read musical notation
  - Musical phrasing, playing with feeling
  - Creative musicality

- **Science**
  - Building conceptual claims, meanings
  - Evaluating conceptual claims, meaning
  - Seeking evidence
  - Seeking explanations
  - Communicating

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**Nature of Learning**

- Humans are goal-directed agents who actively seek and use information.
- Prior knowledge, misconceptions, skills, beliefs and concepts significantly influence what humans notice about the environment, how they organize knowledge and use knowledge.
- Competence in an area of inquiry requires a deep foundation of factual knowledge, an understanding of facts and ideas within the context of a conceptual framework, and an organization of knowledge that guides retrieval and application.
- People can take control of their learning through active learning that is guided by metacognitive strategies and social interaction.
Linking Assessment to Teaching Practice

Impact of “Interactive Engagement” in Physics

Percent learning gains on standardized pre-and post-tests in physics for 62 courses enrolling N=6542 students in high school, colleges and universities


Program Evaluation

The Evidence Based Decision Making Cycle

Gather Data

Interpret Evidence

Mission/Purposes

Goals

Outcomes

Implement Methods to Deliver Outcomes and Methods to Gather Data

Make decisions to improve programs; enhance student learning and development; inform institutional decision-making, planning, budgeting, policy, public accountability

Adapted from Peggy Maki, Ph.D. by Marilee J. Bresciani, Ph.D.
Activity:
Seeking Change

Group discussion: What would you like to change?