

The Gentle Art of Questioning

CONNECTING LEARNING GOALS AND ASSESSMENTS

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Learning goals

- **Definition: What students should be able to do after completing a course**
- **Requirement: Must be measurable**
⇒ *assessment and goals tightly linked*
 - ✓ Your goals should reflect what you value in the student learning process
 - ✓ Often, students never know what your goals are!

Three levels:

Course scale (5-10 per course) ⊙ Topic-scale (2-5 per topic) ⊙
Class-scale (2-3 per class period)

Types of Knowledge / Learning Goals

FACTS:

Terminology, information, details

CONCEPTS

Classifications, categories, principles, models, reasoning.
Analyze, explain, and predict the world around you

PROCEDURES:

Skills, techniques, methods, problem-solving
Thinking like a scientist: Use alternative representations, compare and contrast, strategize, justify, design an experiment, create a graph.

METACOGNITIVE

Self-awareness about what helps you learn; studying & learning strategies.

AFFECTIVE (attitudes & beliefs):

Appreciate, enjoy, value. Recognize that the behavior of the world around you is not magical and mysterious, but rather can be understood and predicted using certain fundamental principles.)

Handout

Bloom's Levels and Associated Verbs* Lower order cognitive level = LOC Higher order cognitive level = HOC

LOC or HOC	Bloom's Levels and Associated Verbs
LOC (1)	Knowledge: arrange, define, duplicate, label, list, memorize, name, order, recognize, relate, recall, repeat, reproduce state
LOC (2)	Comprehension: classify, describe, discuss, explain, express, identify, indicate, locate, recognize, report, restate, review, select, translate
LOC or HOC (3)	Application: apply, choose, demonstrate, dramatize, employ, illustrate, interpret, operate, practice, schedule, sketch, solve, use, write
HOC (4)	Analysis: analyze, appraise, calculate, categorize, compare, contrast, criticize, differentiate, discriminate, distinguish, examine, experiment, question, test
HOC (5)	Synthesis: arrange, assemble, collect, compose, construct, create, design, develop, formulate, manage, organize, plan, prepare, propose, set up, write
HOC (6)	Evaluation: appraise, argue, assess, attach, choose, compare, defend estimate, judge, predict, rate, core, select, support, value, evaluate

Credit: Jenny Knight, University of Colorado, Boulder, October, 2011

* Original by Bloom (1956). Recently, Anderson and Krathwohl, [(2001), A Taxonomy for learning, teaching, and assessing.] have suggested that synthesis should be level 6 and evaluation should be level 6. Many put these two levels into practice simultaneously, using 5/6 as the Bloom's level.

EXERCISE #1

Type of Knowledge	Cognitive Process Level (Bloom's)					
	1 Remember	2 Understand	3 Apply	4 Analyze	5 Evaluate	6 Synthesize
A. Factual knowledge						
B. Conceptual knowledge						
C. Procedural knowledge (skills)						
D. Meta-cognitive knowledge						
E. Attitudes and beliefs						

Check-list for creating **class-scale** learning goals:

- Is goal expressed in terms of **what the student will achieve** or be able to do?
- Is the **Bloom's level** of the goal aligned with your actual expectations?
- Is the goal **well-defined**? Is it clear how you would measure achievement?
- Do chosen verbs have a **clear** meaning?
- Is **terminology familiar**/common? If not, is the terminology a goal?
- Is it **relevant and useful** to students? (e.g. connected to their everyday life OR does it represent a useful application of the ideas).

EXERCISE #2: The Frustrated Student



I am a junior majoring in physics. I was thinking I might go to graduate school to do research and become a professor, or maybe apply for an industrial internship. I usually get As in my courses, only a few B's so far in college. I totally breezed through high school, it was so easy.

This semester, I enrolled in Electricity & Magnetism. I approach this class like most others: I attend lecture (have only missed two), read the textbook (usually before class), and turn in the homework if it's going to be graded. Prof. Lopez is great; he's really well organized and follows the book closely. The homework has been helpful for learning the terms and information.

The first midterm exam in this course was NOT what I expected. None of the questions were multiple choice. We had to write out short (and sometimes LONG) answers. I barely finished it in the 2-hour exam period. Plus, three of the questions tested us on things we had never learned and skipped stuff we had covered in class. For example, we learned about skin depth, and it wasn't even on the test. But there was this question about asking us, "What will be the voltage at infinity if the voltage at the center of a charged sphere is set to zero, explain your reasoning." How am I supposed to know about that? I got a 55 on that test. What a crock! Forget physics, it's not for me.

Adapted from Handelsman, Miller & Pfund, 2007

EXERCISE #2: The Frustrated Student



Key questions to guide your discussion

- ✓What issues might be contributing to this situation?
- ✓Do the assessments give the student any feedback about what they understand while they are learning about this topic?
- ✓What do the assessments motivate the student to learn? What effect this professor's assessment will have on student behavior for the next test? Do you think that was the intention?
- ✓What suggestions do you have for the professor?
- ✓Have you faced a similar challenge?

Adapted from Handelsman, Miller & Pfund, 2007

<p>EXERCISE #3: Compare & Contrast</p>	<p>Case 1: Each week, students are assigned a reading. All students take a 10-minute quiz that tests factual knowledge. Quizzes are handed in for points.</p>	<p>Case 2: Each week, students are assigned a reading. All students generate a diagram or concept-map to illustrate the concept from the reading on their own. They explain their figure to each other in small groups for 10 minutes at the start of class. After discussion, they write a one-minute paper to explain what they learned. Diagrams and papers are handed in for points.</p>
<p>How does the assessment motivate students to learn the material or figure out the concepts they don't understand?</p>		
<p>How does the assessment capitalize on the diversity of learners?</p>		
<p>Does the assessment help students gauge what they know or how well they understand the key learning goals?</p>		
<p>Does the assessment build skills in giving and receiving critical feedback (learning how to learn)?</p>		
<p>Write your own questions here:</p>		
<p>Adapted from Handelsman, Miller & Pfund, 2007</p>		

<h2>Exercise #4: Alignment</h2>			
<p>Learning goal (where are you going?) <i>From previous activity</i></p>	<p>Likely student prior knowledge/ misconceptions (Where are you at?)</p>	<p>Example learning activity = formative assessment (How are you going to get there?)</p>	<p>Summative / formative assessment question (Are we there yet?) <i>From exam or write a new one</i></p>
<p>Adapted from Handelsman, Miller & Pfund, 2007</p>			

Exercise #5: Grading



I attended a workshop about assessment, and the main thing I learned is that I'm supposed to assess students before class so I can target what the students need to know. So, I created a series of pre-class quizzes for the students, but most students don't do them because they are not graded. However, I don't have the time to grade 320 of these each week – much less the other 16 assessments the workshop suggested. I'll just go back to trusting my gut to know how well the students are doing.

Key questions to guide discussion:

- ✓What issues might be contributing to this situation?
- ✓What is this professor's definition of "assessment"?
- ✓Other than grades, what strategies could motivate the students to participate in the assessment?
- ✓What suggestions do you have for the professor?
- ✓Have you faced a similar challenge?

Adapted from Handelsman, Miller & Pfund, 2007

ACTION PLAN



Which tools, strategies or resources from today's workshop will be most helpful to you in teaching this semester or in the near future?

Think of your last few lectures. What topics have you struggled to teach?

List two colleagues who could help you brainstorm ways to address this struggle using assessment tools:

- 1.
- 2.

Next time you teach, try one of the strategies that you and your colleague identify. How will you know if the strategy is successful? What will you observe or measure?

Adapted from Handelsman, Miller & Pfund, 2007

References & Resources



You can always contact me, at stephanie@sciencegeekgirl.com

1. **Learning goals resource page**, with one-page tipsheets and examples:
http://www.cwsei.ubc.ca/resources/learn_goals.htm
2. **Clicker resource page** with videos, question banks, and more:
<http://STEMclickers.colorado.edu>

Suggested Reading:

1. Handelsman, Miller & Pfund, 2007, *Scientific Teaching*. New York: WH Freeman & Co.
2. Smith & Perkins, 2010, At the end of my course students should be able to... *Microbiology Australia*, March. (linked within Learning Goals resource page)
3. Angelo & Cross, 1993, *Learner-Centered Assessment on College Campuses*, Needham Heights, MA: Allyn & Bacon