Leadership Virtual Community of Practice (LVCP)

Cindy Finelli - Karl A. Smith
University of Michigan -
Purdue University/University of Minnesota

cfinelli@umich.edu - ksmith@umn.edu

Taxonomies of Types of Learning - Elaboration

October 21, 2013

Taxonomies of Types of Learning

Bloom's taxonomy of educational objectives: Cognitive Domain (Bloom & Krathwohl, 1956)

A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives (Anderson & Krathwohl, 2001).

Facets of understanding (Wiggins & McTighe, 1998)

Taxonomy of significant learning (Fink, 2003)

Evaluating the quality of learning: The SOLO taxonomy (Biggs & Collis, 1982)

The Six Major Levels of Bloom's Taxonomy of the Cognitive Domain
(with representative behaviors and sample objectives)

Knowledge. Remembering information *Define, identify, label, state, list, match*

Identify the standard peripheral components of a computer
Write the equation for the Ideal Gas Law

Comprehension. Explaining the meaning of information *Describe, generalize, paraphrase, summarize, estimate*

In one sentence explain the main idea of a written passage
Describe in prose what is shown in graph form

Application. Using abstractions in concrete situations *Determine, chart, implement, prepare, solve, use, develop*

Using principles of operant conditioning, train a rate to press a bar
Derive a kinetic model from experimental data

Analysis. Breaking down a whole into component parts *Points out, differentiate, distinguish, discriminate, compare*

Identify supporting evidence to support the interpretation of a literary passage
Analyze an oscillator circuit and determine the frequency of oscillation

Synthesis. Putting parts together to form a new and integrated whole *Create, design, plan, organize, generate, write*

Write a logically organized essay in favor of euthanasia
Develop an individualized nutrition program for a diabetic patient

Evaluation. Making judgments about the merits of ideas, materials, or phenomena *Appraise, critique, judge, weigh, evaluate, select*

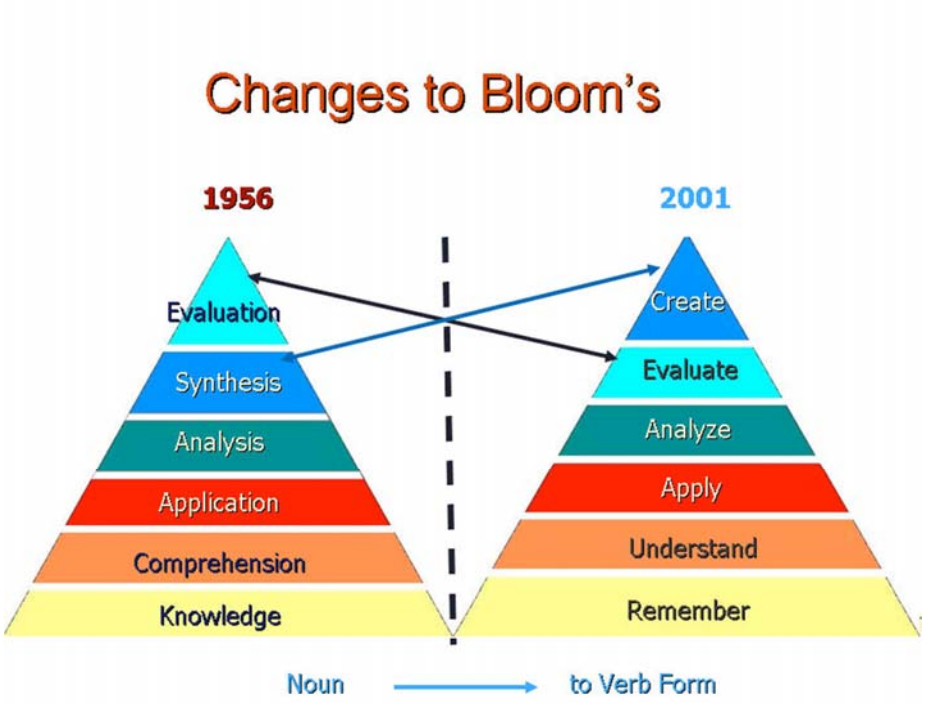
Assess the appropriateness of an author's conclusions based on the evidence given
Select the best proposal for a proposed water treatment plant

The Cognitive Process Dimension

The Knowledge Dimension

	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual Knowledge – The basic elements that students must know to be acquainted with a discipline or solve problems in it. a. Knowledge of terminology b. Knowledge of specific details and elements						
Conceptual Knowledge – The interrelationships among the basic elements within a larger structure that enable them to function together. a. Knowledge of classifications and categories b. Knowledge of principles and generalizations c. Knowledge of theories, models, and structures						
Procedural Knowledge – How to do something; methods of inquiry, and criteria for using skills, algorithms, techniques, and methods. a. Knowledge of subject-specific skills and algorithms b. Knowledge of subject-specific techniques and methods c. Knowledge of criteria for determining when to use appropriate procedures						
Metacognitive Knowledge – Knowledge of cognition in general as well as awareness and knowledge of one's own cognition. a. Strategic knowledge b. Knowledge about cognitive tasks, including appropriate contextual and conditional knowledge c. Self-knowledge						

(Anderson & Krathwohl, 2001).



http://www.uwsp.edu/education/lwilson/curric/newtaxonomy.htm

A Model of Learning Objectives

based on

A Taxonomy for Learning, Teaching, and Assessing:
A Revision of Bloom's Taxonomy of Educational Objectives

Among other modifications, Anderson and Krathwohl's (2001) revision of the original Bloom's taxonomy (Bloom & Krathwohl, 1956) redefines the cognitive domain as the intersection of the Cognitive Process Dimension and the Knowledge Dimension. This document offers a three-dimensional representation of the revised taxonomy of the cognitive domain.

Although the Cognitive Process and Knowledge dimensions are represented as hierarchical steps, the distinctions between categories are not always clear-cut. For example, all procedural knowledge is not necessarily more abstract than all conceptual knowledge; and an objective that involves analyzing or evaluating may require thinking skills that are no less complex than one that involves creating. It is generally understood, nonetheless, that lower order thinking skills are subsumed by, and provide the foundation for higher order thinking skills.

The Knowledge Dimension classifies four types of knowledge that learners may be expected to acquire or construct—ranging from concrete to abstract (Table 1).

Table 1. The Knowledge Dimension – major types and subtypes

concrete knowledge → abstract knowledge			
factual	conceptual	procedural	metacognitive*
knowledge of terminology knowledge of specific details and elements	knowledge of classifications and categories knowledge of principles and generalizations knowledge of theories, models, and structures	knowledge of subject-specific skills and algorithms knowledge of subject-specific techniques and methods knowledge of criteria for determining when to use appropriate procedures	strategic knowledge knowledge about cognitive tasks, including appropriate contextual and conditional knowledge self-knowledge

(Table 1 adapted from Anderson and Krathwohl, 2001, p. 46.)
*Metacognitive knowledge is a special case. In this model, "metacognitive knowledge is knowledge of [one's own] cognition and about oneself in relation to various subject matters . . ." (Anderson and Krathwohl, 2001, p. 44).

IOWA STATE UNIVERSITY
Center for Excellence in Learning and Teaching

http://www.celt.iastate.edu/pdfs-docs/teaching/RevisedBloomsHandout.pdf

This taxonomy provides a framework for determining and clarifying learning *objectives*.
Learning *activities* often involve both lower order and higher order thinking skills as well as a mix of concrete and abstract knowledge.

The Cognitive Process Dimension represents a continuum of increasing cognitive complexity—from lower order thinking skills to higher order thinking skills. Anderson and Krathwohl (2001) identify nineteen specific cognitive processes that further clarify the scope of the six categories (Table 2).

Table 2. The Cognitive Processes dimension — categories & cognitive processes and alternative names

lower order thinking skills → higher order thinking skills

remember	understand	apply	analyze	evaluate	create
recognizing • identifying recalling • retrieving	interpreting • clarifying • paraphrasing • representing • translating exemplifying • illustrating • instantiating classifying • categorizing • subsuming summarizing • abstracting • generalizing inferring • concluding • extrapolating • interpolating • predicting comparing • contrasting • mapping • matching explaining • constructing models	executing • carrying out implementing • using	differentiating • discriminating • distinguishing • focusing • selecting organizing • finding coherence • integrating • outlining • parsing • structuring attributing • deconstructing	checking • coordinating • detecting • monitoring • testing critiquing • judging	generating • hypothesizing planning • designing producing • constructing

(Table 2 adapted from Anderson and Krathwohl, 2001, pp. 67–68.)

IOWA STATE UNIVERSITY
Center for Excellence in Learning and Teaching

Dee Fink – Creating Significant Learning Experiences

A TAXONOMY OF SIGNIFICANT LEARNING

Cognitive

1. Foundational Knowledge

- "Understand and remember" learning

  For example: facts, terms, formulae, concepts, principles, etc.

2. Application

- Thinking: critical, creative, practical (problem-solving, decision-making)
- Other skills

  For example: communication, technology, foreign language
- Managing complex projects

3. Integration

- Making "connections" (i.e., finding similarities or interactions) . . .

  Among: ideas, subjects, people

Affective

4. Human Dimensions

- Learning about and changing one's SELF
- Understanding and interacting with OTHERS

5. Caring

- Identifying/changing one's feelings, interests, values

Meta

6. Learning How to Learn

- Becoming a better student
- Learning how to ask and answer questions
- Becoming a self-directed learner

Facets of Understanding
Wiggins & McTighe, 1998, page 44

When we truly understand, we

- *Can **explain***
- *Can **interpret***
- Can ***apply***
- Have ***perspective***
- Can ***empathize***
- Have ***self-knowledge***

SIX FACETS OF UNDERSTANDING

Six Facets	Description	Example
Explanation	To ensure students understand why an answer or approach is the right one. Students explain or justify their responses or justify their course of action.	Students develop an illustrated brochure to explain the principles and practices of a particular type of technology (i.e., transportation, construction, medical, information).
Interpretation	To ensure students avoid the pitfall of looking for the "right answer" and demand answers that are principled…students are able to encompass as many salient facts and points of view as possible.	Students develop a 'biography' of the development of a particular type of technology.
Application	To ensure students' key performances are conscious and explicit reflection, self-assessment, and self-adjustment, with reasoning made evident. Authentic assessment requires a real or simulated audience, purpose, setting, and options for personalizing the work, realistic constraints, and "background noise."	Students analyze a design of a product, taking it apart in order to determine how it works. Students design, develop, test, and revise a solution to a local issue, such as a new roadway system, a water treatment system, or long-term storage of various materials.
Perspective	To ensure students know the importance or significance of an idea and to grasp its importance or unimportance. Encourage students to step back and ask, "What of it?" "Of what value is this knowledge?" "How important is this idea?" "What does this idea enable us to do that is important?"	Students investigate about a technological artifact from the perspective of different regions and countries.
Empathy	To ensure students develop the ability to see the world from different viewpoints in order to understand the diversity of thought and feeling in the world.	Students imagine they are politicians debating the value of nuclear power. They write their thoughts and feelings explaining why they agree or disagree with the use of nuclear power.
Self-Knowledge	To ensure students are deeply aware of the boundaries of their own and others' understanding; able to recognize their own prejudices and projections; has integrity – able and willing to act on what one understands	Students reflect on their own progress of understanding about one of the standards in *Standards for Technological Literacy: Content for the Study of Technology*. They evaluate the extent to which they have improved, what task or assignment was the most challenging and why, and which project or product of work they are most proud of and why.

Source: Wiggins, G., & McTighe, J. (1998). *Understanding by Design*. p. 85-97. Alexandria, VA: Association for Supervision and Curriculum Development

SOLO Taxonomy

- The **Structure of Observed Learning Outcome** (**SOLO**) model consists of 5 levels of understanding
  - **Pre-structural** - The task is not attacked appropriately; the student hasn't really understood the point and uses too simple a way of going about it.
  - **Uni-structural** - The student's response only focuses on one relevant aspect.
  - **Multi-structural** - The student's response focuses on several relevant aspects but they are treated independently and additively. Assessment of this level is primarily quantitative.
  - **Relational** - The different aspects have become integrated into a coherent whole. This level is what is normally meant by an adequate understanding of some topic.
  - **Extended abstract** - The previous integrated whole may be conceptualised at a higher level of abstraction and generalised to a new topic or area.

http://en.wikipedia.org/wiki/Structure_of_Observed_Learning_Outcome

Teaching Teaching and Understanding Understanding

- Biggs SOLO taxonomy

- http://video.google.com/videoplay?docid=-5629273206953884671#