Thermo Virtual Community of Practice (VCP)

Session 3: Learning objectives and Bloom's taxonomy

April 17, 2013

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Tentative Agenda

- Introductions, Objectives ~ 10 min
- Blooms taxonomy~ 7 min
- Relation to ILOs and each group share examples~ 15 min (group)
- Other taxonomies~ 5 min
- Group reflection: use? ~ 3 min
- Poll - use of "living" syllabus as portfolio for integrating VCP concepts ~ 5 min
- Wrap-up and next week ~ 5 min

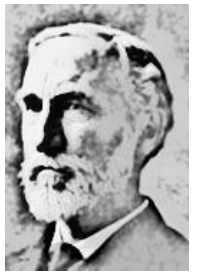
Team Flow

Ganesh Balasubramanian
Iowa State

Jeff LaMack
Milwaukee School of Engineering

Melissa Pasquinelli
North Carolina State

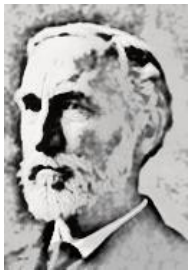
Georg Pingen
Union



Nastaran Hashemi
Iowa State

Team Energy

Nihad Dukhan
Detroit Mercy



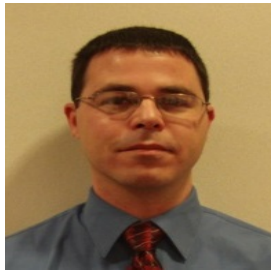
Calvin Li
Villanova

Krishna Pakala
Boise State

Hessam Taherian
Alabama at Birmingham

Robert F Richards
Washington State

Killer Watts



Jamie Canino
Trine

Heather Dillon
Portland

Edwin Wiggins
Webb Institute

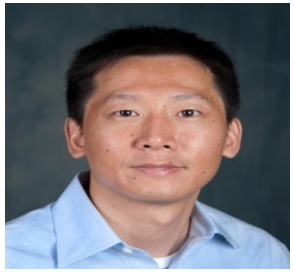
Joseph Tipton
Evansville

Bilal El-Zahab
Florida International

Team Green Engineering

Margot Vigeant
Bucknell

John O'Connell
Virginia



Zhihua Xu
Minnesota Duluth

Sapna Sarupina
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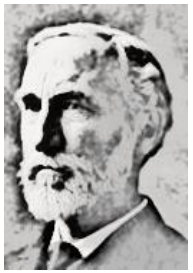


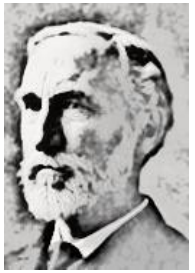
Bernie van Wie
Washington State

TdS

Sooby Bhattacharjee
San Diego State

Ashland Brown
Pacific

Betta Fisher
Cornell



H. S. Udaykumar
Iowa

Team Cycle

John Chen
California Polytechnic

Milo Koretsky
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Sadi Carnot
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Objectives

- Understand the elements of Bloom's taxonomy and the modified Bloom's taxonomy
- Apply these or other taxonomies to write ILOs
- Identify other taxonomies of learning/knowledge and evaluate what differs between them

Bloom's Taxonomy

1 ***Knowledge***: The student can recall information.

arrange, define, duplicate, label, list, memorize, name, order, recognize, relate, recall, repeat, reproduce state.

2 ***Comprehension***: Information is understood or can be interpreted.

classify, describe, discuss, explain, express, identify, indicate, locate, recognize, report, restate, review, select, translate,

3 ***Application***: Concepts are employed to solve problems in new situations.

apply, choose, demonstrate, dramatize, employ, illustrate, interpret, operate, practice, schedule, sketch, solve, use, write.

4 ***Analysis***: Material that defines a problem or idea is broken into parts. The individual parts are understood, along with the relationships between them.

analyze, appraise, calculate, categorize, compare, contrast, criticize, differentiate, discriminate, distinguish, examine,

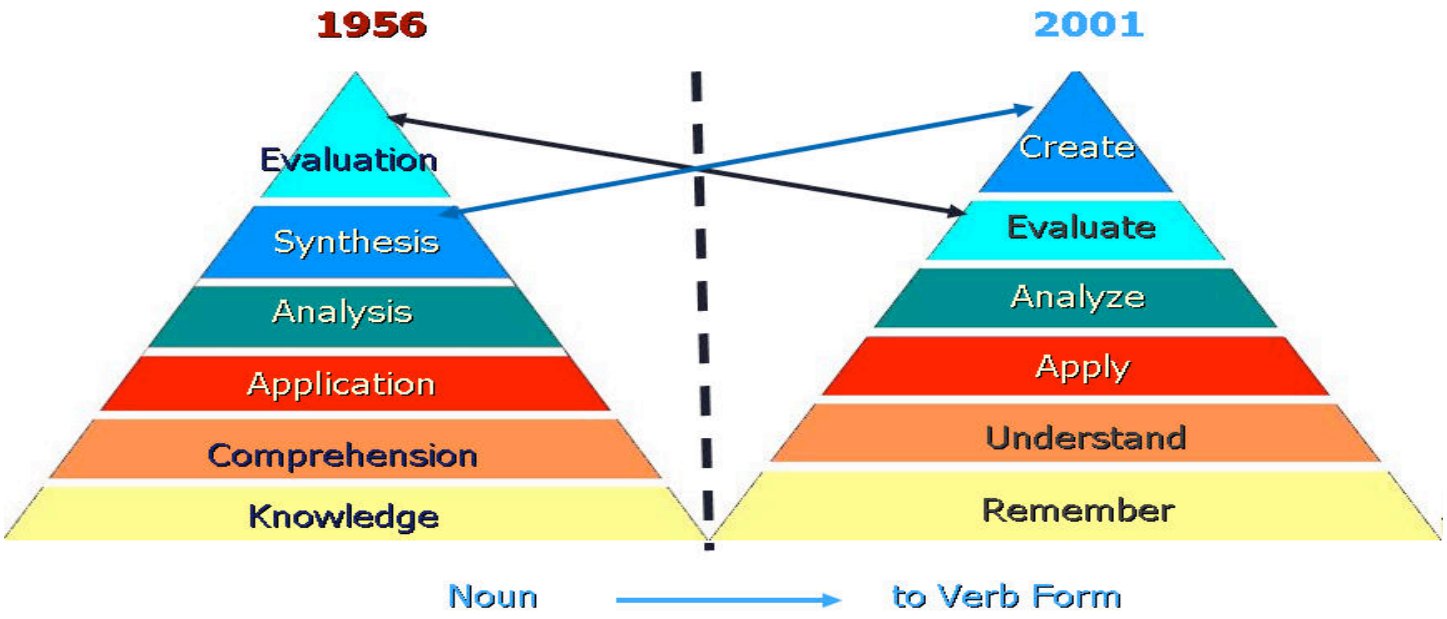
5 ***Synthesis***: Concepts formed in previous experiences are combined with new material to create ideas that integrate all of the information.

arrange, assemble, collect, compose, construct, create, design, develop, formulate, manage, organize, plan, prepare.

6 ***Evaluation***: New ideas are compared to existing theories and evaluated accordingly.

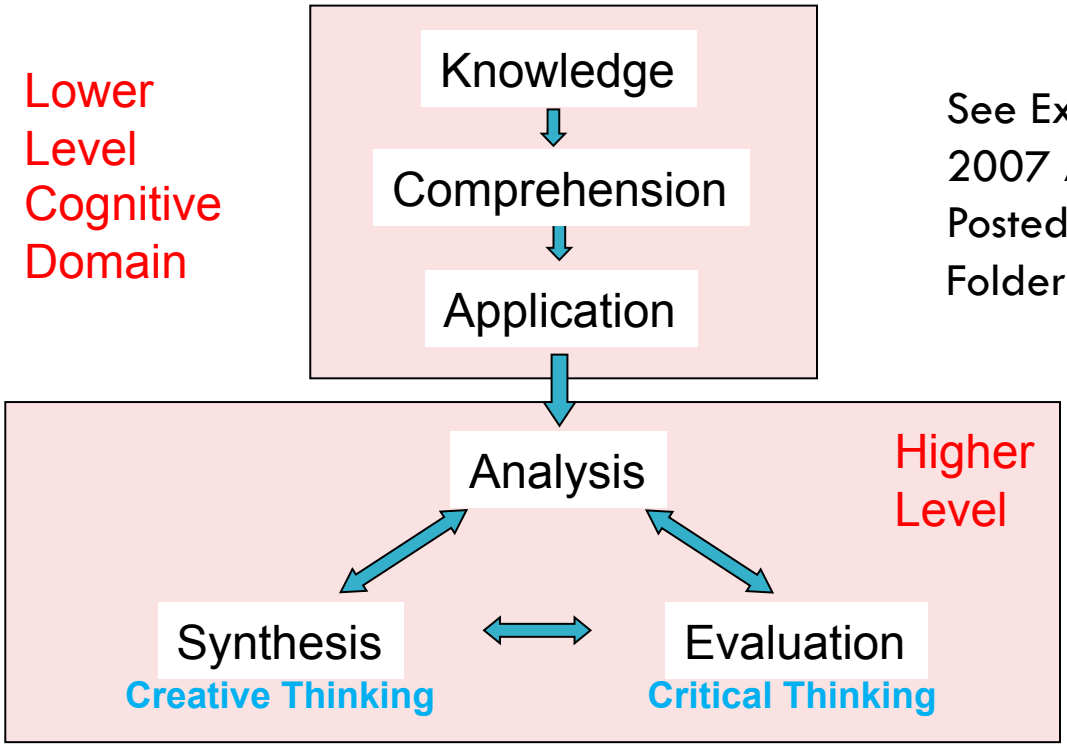
appraise, argue, assess, attach, choose compare, defend estimate, judge, predict, rate, select, support, value, evaluate.

Changes to Bloom's



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

Bloom's Taxonomy- another take



See Example from 2007 ASEE Conference Posted in Week 3 Folder

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).

Relation between Bloom and ILOs

- Share the two Learning Objectives based on different places in Bloom's Taxonomy (or the SOLO taxonomy):
  - Tds
  - Green Engineering
  - Team Flow
  - Team Energy
  - Killer Watts

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).
- Evaluating the quality of learning: The SOLO taxonomy (Biggs & Collis, 1982)
- Taxonomy of significant learning (Fink, 2003)
- Facets of understanding (Wiggins & McTighe, 1998)

SOLO Taxonomy (from Biggs and Tang)

Some typical declarative and functioning knowledge verbs by SOLO level

	declarative knowledge	*functioning knowledge*
unistructural	memorize, identify, recite.	count, match, order.
multistructural	describe, classify.	compute, illustrate.
relational	compare and contrast explain, argue, analyze.	apply, construct, translate, solve near problem, predict within same domain.
extended abstract	theorize, hypothesize, generalize.	reflect and improve, invent, create, solve unseen problems, predict to unknown domain.

SOLO Taxonomy (from Biggs and Tang)

- 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

A Taxonomy of Significant Learning (Fink)

- **Foundational Knowledge** Understand and remember" learning For example: facts, terms, formulae, concepts, principles, etc.
- **Application** Thinking: critical, creative, practical (problem-solving, decision-making) Other skills For example: communication, technology, foreign language, Managing complex projects
- **Integration** Making "connections" (i.e., finding similarities or interactions) . . . Among: ideas, subjects, people
- **Human Dimensions** Learning about and changing one's SELF Understanding and interacting with OTHERS
- **Caring** Identifying/changing one's feelings, interests, values
- **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.

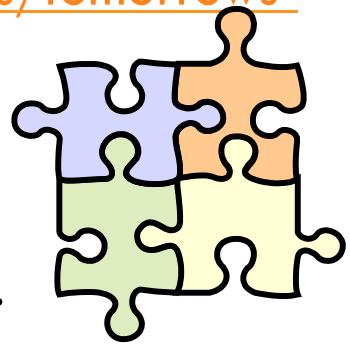
Source: Wiggins, G., & McTighe, J. (1998). *Understanding by Design*. p. 85-97. Alexandria, VA: Association for Supervision and Curriculum Development

VCP Discussion

- Can awareness of these taxonomies facilitate improved course design?
- Poll - use of "living" syllabus as portfolio for integrating VCP concepts

For Session 4: April 24, 2013

- Interactive learning techniques
  - Watch the video about Peer Instruction at (middle of the page) http://americanradioworks.publicradio.org/features/tomorrows-college/lectures/rethinking-teaching.html
- Each VCP team summarize in 1 or 2 slides your assigned paper (week 3 folder) to present at the next session. Get slides to Milo by noon 4/23.



- Update your syllabus based on VCP this far with track changes (?)