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DO EDUCATIONAL TAXONOMIES LEAD TO EXCELLENCE IN TEACHING…?

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Overview

- How do students learn?
- Educational Taxonomies
- Is there a universal ‘student’ attention span?
- Supplemental Multimedia Online Learning Tool (SMOLT)
- Experiential Learning and Entrepreneurship

How do Students Learn - 1988

- Visual information cannot be effectively taught using the written word
- Most college students are visual learners
- Most traditional college courses are taught using a combination of verbal and auditory
- To better accommodate visual learning students, educators should add more visually stimulating materials, such as pictures, diagrams, and sketches

Bonus Homework (9/28/2005) **Name:_____** **Due on Weds Sept 21, 2005**

INDEX OF LEARNING STYLES

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'Learning and Teaching Styles In Engineering Education',
R. M. Felder and L. K. Silverman,
Engr. Education, 78 (7), 674–681 (1988)

How do Students Learn - 2000

- Active learning methods make classes much more enjoyable for both students and instructors
- After 10-20 minutes in most classes
  - students' attention starts to drift
- By the end of most classes
  - boredom is rampant
- Immediately after a full lecture
  - students were able to recall about 70% of the content presented in the first ten minutes
  - only 20% of the content of the last ten minutes

Active learning methods make classes much more enjoyable for both students and instructors

THE FUTURE OF ENGINEERING EDUCATION II. TEACHING METHODS THAT WORK
R. M. Felder, D. R. Woods, J. E. Stice, A. Rugarcia
Chem. Engr. Education, 34 (1), 26–39 (2000)

How do Students Learn - 2009

- The downside to the lecture format is that there is little dialogue between lecturer and student
- Given the usually 'passive' nature of lecture
  - it is difficult to tell if students are learning
  - lecture can not facilitate skills training

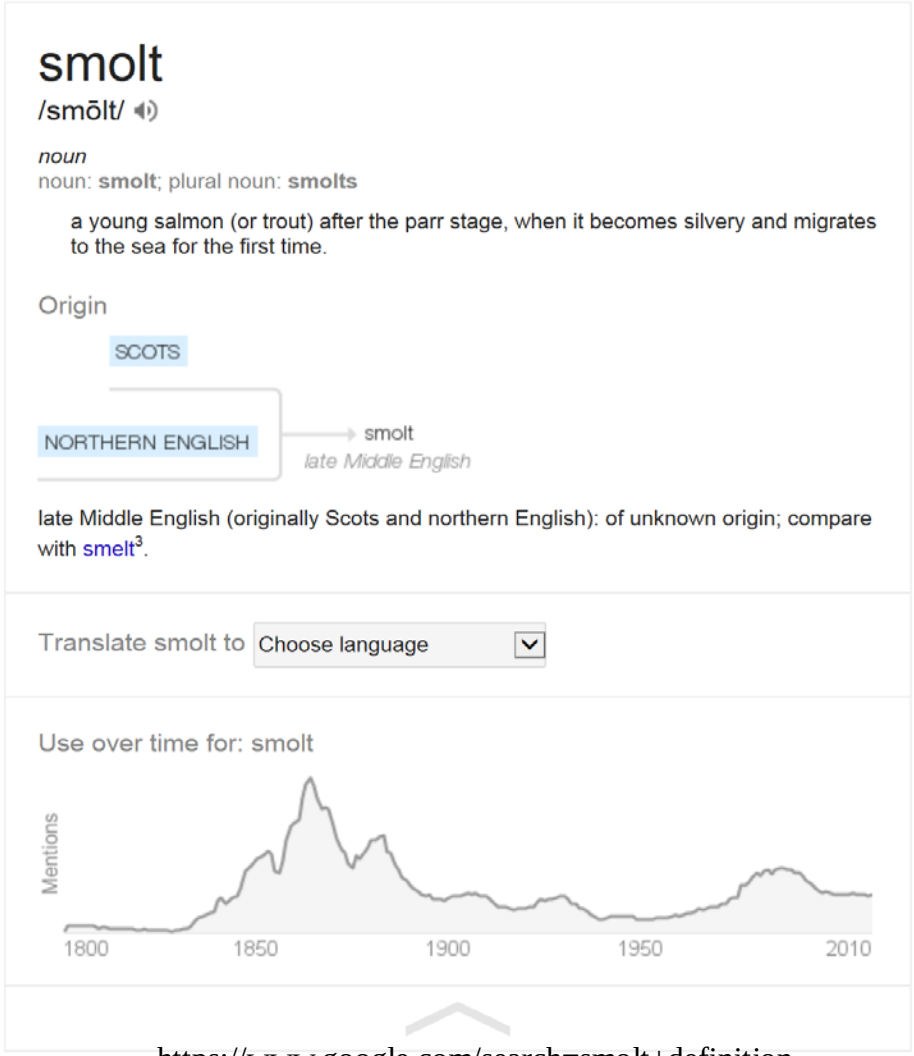
Active learning affords the opportunity for application and practice, and the asking of questions and makes it possible to assess and remediate student understanding in real time

'Flipping the Work Design in an Industrial Engineering Course'
R. Toto and H. Nguyen
39th ASEE/IEEE **FiE, 2009, San Antonio, TX**

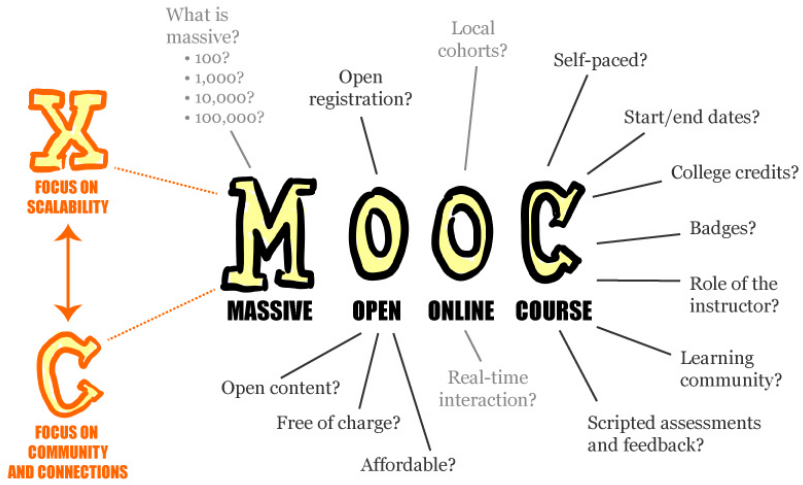
Massive Open Online Course (MOOC)

- Multimedia forms of obtaining information have been recognized in the last 20 years as a way to supplement classroom instruction.
    - BEST (Basic Engineering Software for Teaching) for dynamics
    - EDICS (Engineering Design Instructional Computer Program) which took the students through a series of interactive screens that included media such as pictures, animations, videos, and even games.
- MOOC (Massive Open Online Course) is a form of distance education offered to students that are geographically distributed around the world. The focus of MOOCs was initially to offer courses to non-traditional students.
- A SPOC (Small Private Online Course) is a condensed program offered by Harvard University. SPOCs are also free but have limitations on the number of students who can participate at one time. It is generally understood that students perform better in small, customizable groups.

What is a SMOLT…?



https://www.google.com/search=smolt+definition



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

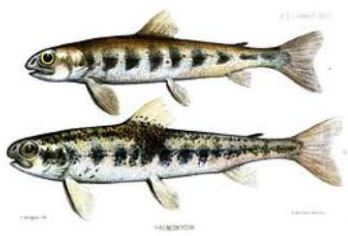
Supplemental Multimedia Online Learning Tool (SMOLT)

SMOLT as taxonomy…?

Salmon eggs. The growing larvae can be seen through the transparent egg envelope. The black spots are the eyes.

Salmon egg hatching into a *sac fry*. In a few days, the sac fry will absorb the yolk sac and become a salmon fry

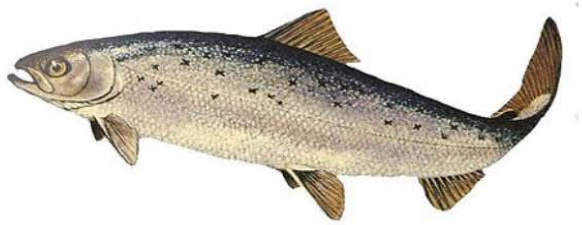
Sac fry remain in the gravel habitat of their redd (nest) while their yolk sac, or "lunch box" is depleted *(click to enlarge)*



The juvenile salmon, *parr*, grow up in the relatively protected natal river

The parr lose their camouflage bars and become *smolt* as they become ready for the transition to the ocean

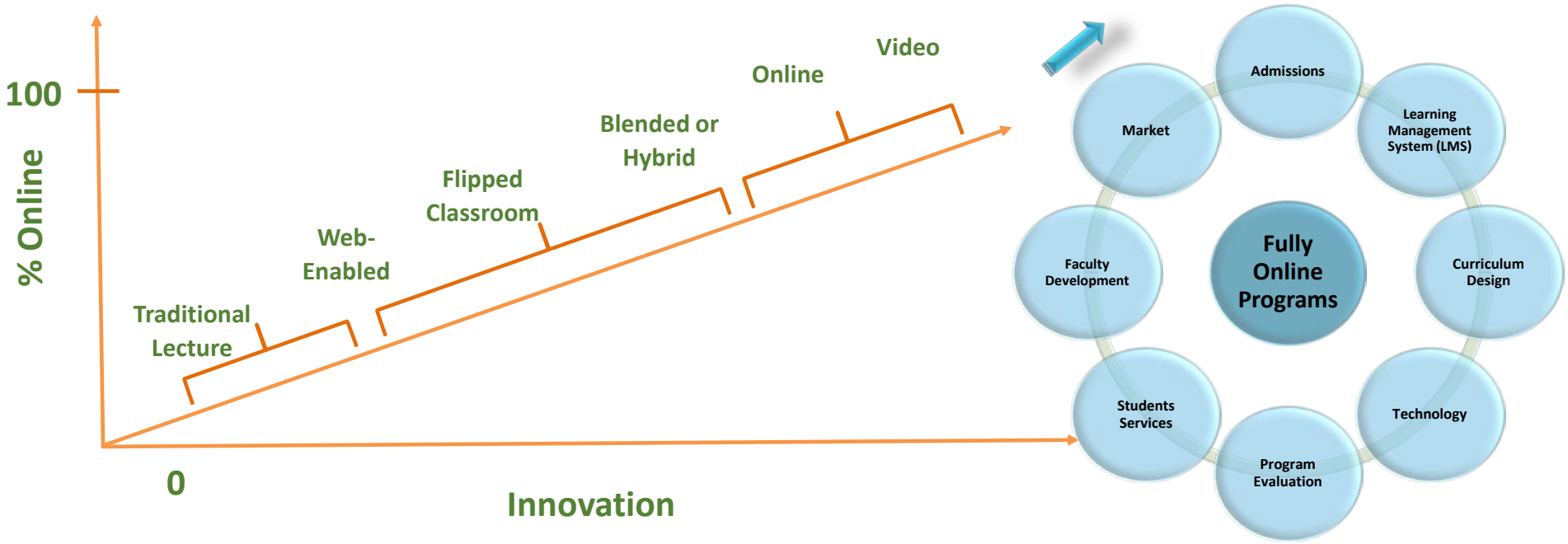
What transitions do engineering students go through during their education?



Salmon enter the ocean as *post-smolt* and mature into adult salmon. They gain most of their weight in the ocean

https://www.google.com/search=smolt+lifestyle

eLearning Spectrum



- Face to face instruction now includes up to 29% of content delivered online.
- Learning outcomes in Online Education compared to Face to Face
  - 22% superior in Online and Hybrid where technology is infused is 16% superior to Online.
- 99% of institutions report they have distance students as part of their enrollment
- Growth of number of students taking a distance / online course from 2003 to 2013 3.7% to 23%

Interest in offering MOOCS has slowly declined over the past three years.

Allen, I.E & Seaman, J. (2015). Grade Level: Tracking Online Education in the United States. Babson Survey Research Group and Quahog Research Group, LLC.

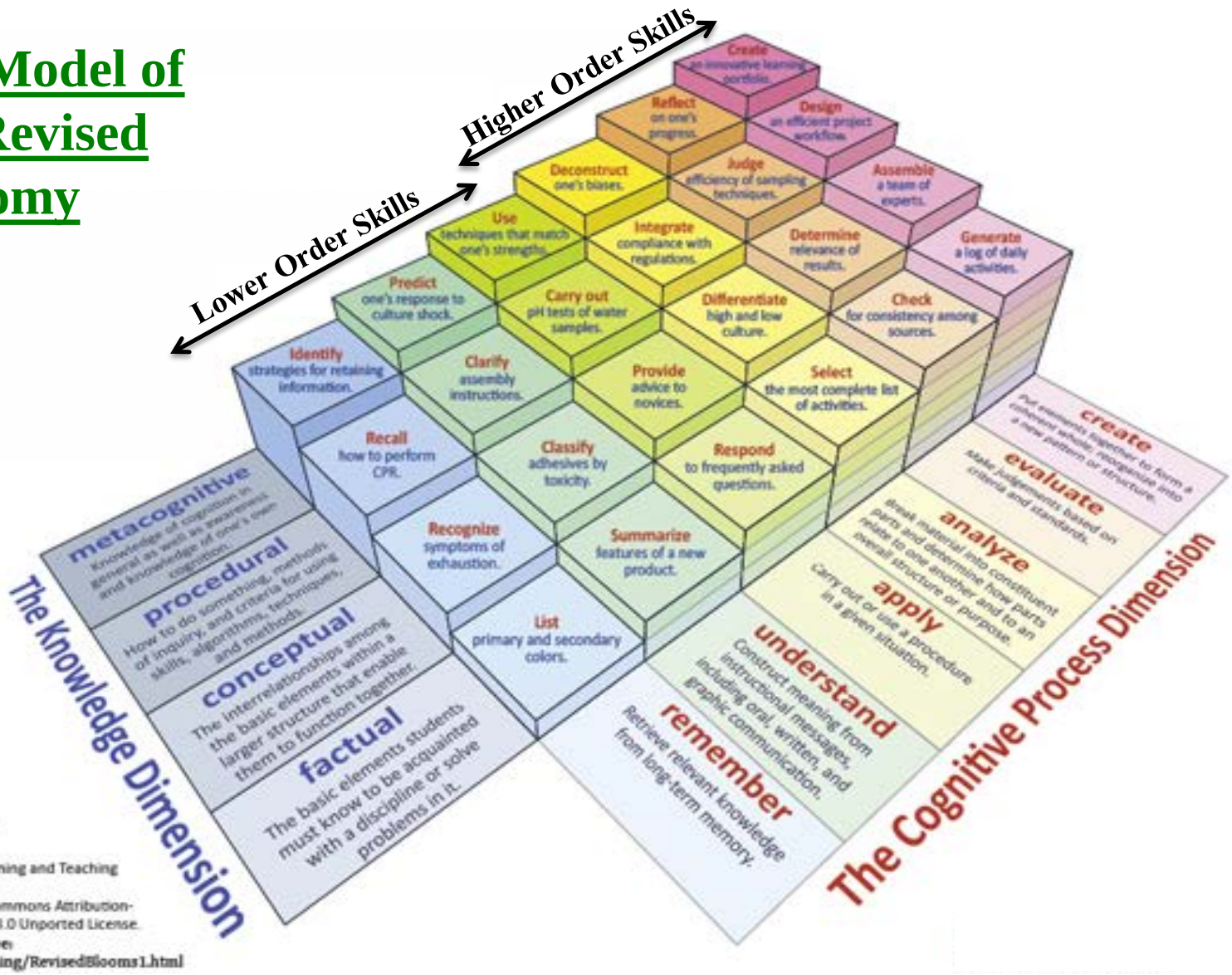
Common Definitions

- **Taxonomy** is the practice and science of taxonomic classification.
  - Bloom's
  - Revised Bloom's
  - SOLO

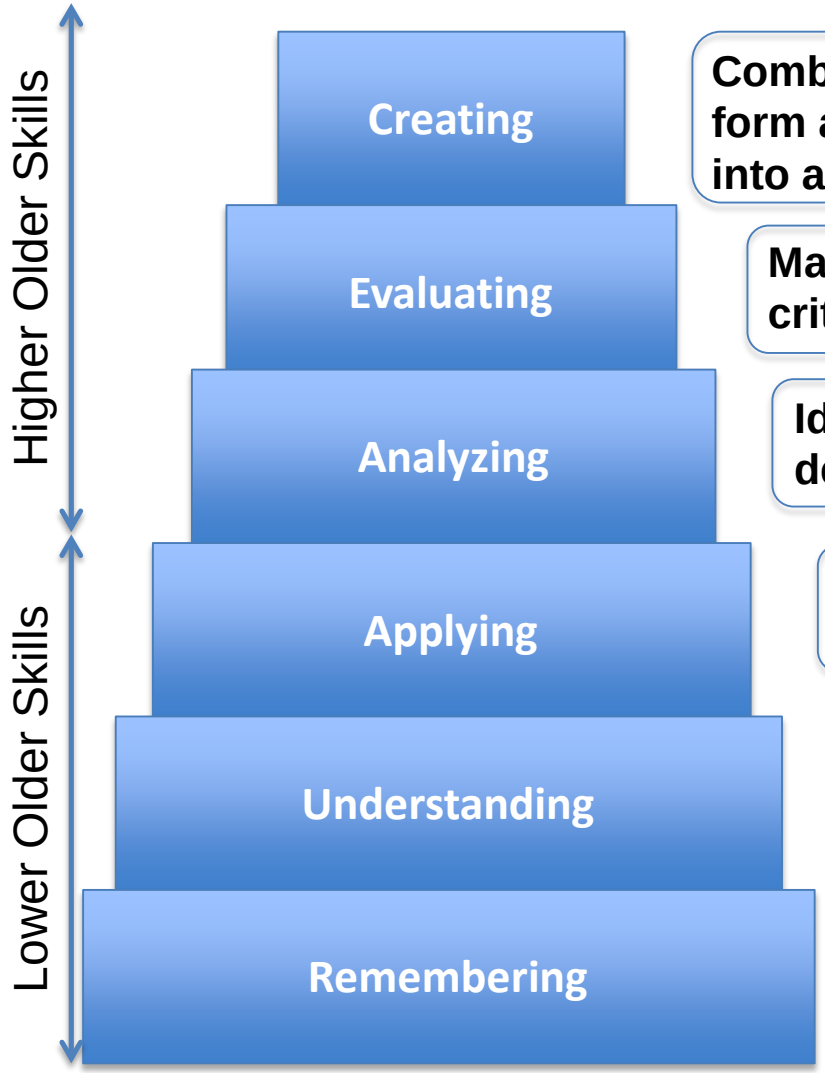
- **Classification** is the act of placing an object or concept into a set or sets of categories (such as a taxonomy or a subject index), based on the properties of the object or concept.

Do educational taxonomies teach us how to teach…?

Expanded Model of Bloom's Revised Taxonomy



Bloom's Revised Taxonomy of Educational Outcomes



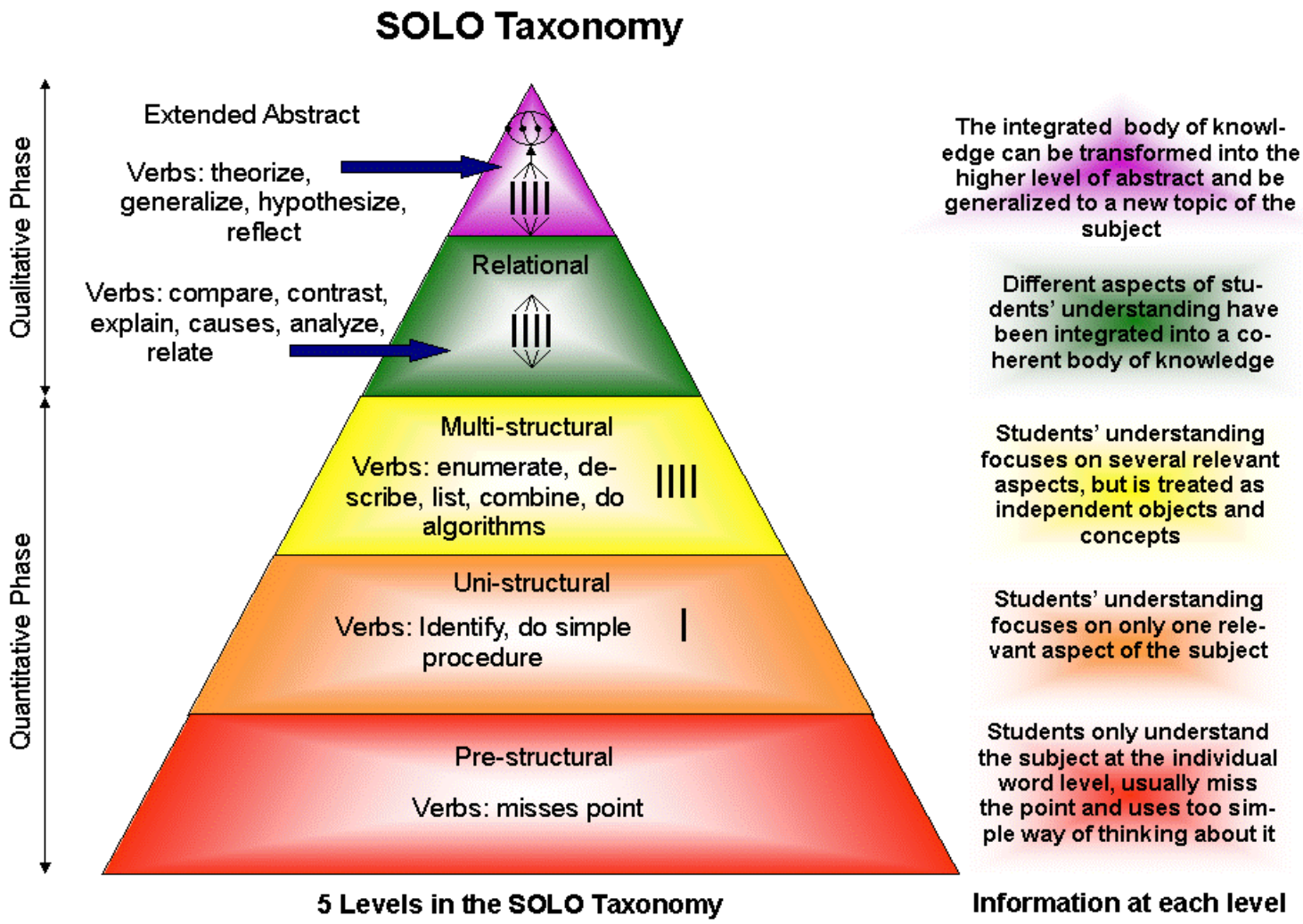
Creating	Combining elements together to form a coherent whole; reorganize into a new pattern or structure	Design, hypothesize, invent, develop, compose, test,
Evaluating	Making decisions based on criteria and standards	Judge, Critique, Justify, Recommend, Assess, Resolve
Analyzing	Identifying components and determining relationships	Categorize, Separate, Dissect, Deduct, Infer, Simplify
Applying	Using information to solve problems	Use, Compute, Demonstrate, Apply, Build, Experiment
Understanding	Constructing meaning from instructional messages	Explain, Describe, Illustrate, Compare, Contrast, Interpret
Remembering	Retrieving relevant knowledge from memory	List, Label, State, Define, Remember, Find, Select, Match

Bloom, B. S.; Engelhart, M. D.; Furst, E. J.; Hill, W. H.; Krathwohl, D. R.
Taxonomy of educational objectives: The classification of educational goals.
Handbook I: Cognitive domain. New York: David McKay Company (1956).

Application of Bloom's Taxonomy to Education

- Bloom's taxonomy could be used to help understand how experiential learning works (Gentry, et al, 1979)
- Creativity is a vital tool for innovation in engineering and can be addressed through meta cognition in experiential learning (Charyton and Merrill, 2009).
- Creativity requires higher thought processes…in many cases, lectures and homework assignments focus on almost exclusively on 'Application'… best way to help students learn higher-levels of thinking is through learning objectives… which ABET criteria addresses (Felder and Brent, 2004).

Structure of Observed Learning Outcomes



www.google.com/search?q=solo+taxonomy+image

SOLO Taxonomy

Prestructural: The student acquires bits of unconnected information that have no organisation and make no sense. This is not a stage that we want to foster through questioning so we will not pursue it further

Unistructural: Students make simple and obvious connections between pieces of information

Multistructural: A number of connections are made, but not the meta-connections between them

Relational: The students sees the significance of how the various pieces of information relate to one another

Extended abstract: At this level students can make connections beyond the scope of the problem or question, to generalise or transfer learning into a new situation

Biggs, J. B. and Collis, K.
Evaluating the Quality of Learning: the SOLO taxonomy.
New York, Academic Press (1982).

Experiential Taxonomy

- **Exposure**: Observes event, shows a willingness and ability to relate the observation and its underlying theory to own previous experience. Is able to analyze and discuss why and how certain aspects, and identifies sources and types of information required to enhance further application of knowledge to the experience.
- **Identification**: Shows the ability to participate in the experience on more sustained basis with less prompting and greater confidence. Shows greater ability to communicate effectively. Demonstrates a wish to acquire further information and ability to analyze and interpret information. Applies problem solving skills and knowledge base to meet different situations.
- **Internalization**: Explains the rationale for an experience, able to transfer knowledge to new situations. Seeks and applies new knowledge and research findings, demonstrates ability to use problem solving skills, critical analysis and evaluation.
- **Participation**: Participates more fully having demonstrated knowledge by analysis. Questions aspects of experience and its rationale, decision-making, practical skills, and means of acquiring further information and opportunities for practice. Shows ability to perform manipulative skills, operationalizes communication and problem solving skills with guidance.
- **Dissemination**: Plans, implementation and evaluates experiences with minimal guidance. Advises others, shows ability to guide others. Critical analysis, evaluation and decision-making skills demonstrated.

Steinaker & Bell, The Experiential Taxonomy, Academic Press, 1979.

Experiential Entrepreneurship

- **Venture creation**
  - New venture development, value creation within organizations
  - Some explicitly geared to for- and non-profit ventures, some geared to for-profit only
- **Business skills/understanding of business principles**
  - Traditional approach around accounting, operations, marketing and technology commercialization
- **Leadership skills**
  - How different are leadership skills from entrepreneurial skills?
  - Leadership definition: influence (motivate) without authority
- **An entrepreneurial "mindset"**

Entrepreneur Traits vs. Mindset

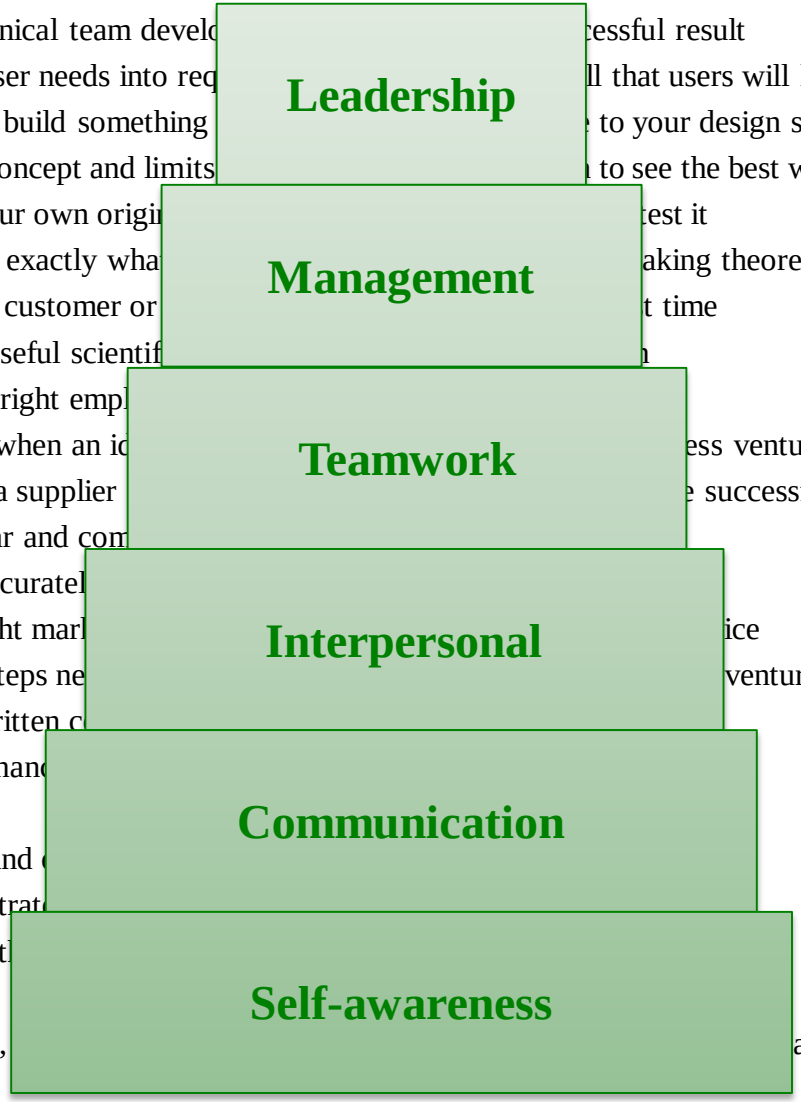
Not all engineers will be entrepreneurs or intrapreneurs (corporate entrepreneurs), but all engineers need to develop an entrepreneurial mindset.

An entrepreneurial mindset is our whole outlook on life, a curiosity level that leads us to understand what is taking place outside of the world we're living in—because ideas can come from anywhere. …wraps itself up to developing an entrepreneurial spirit.

- Robert Kerns, Kerns Foundation

Experiential Entrepreneurship – A Taxonomy

- Lead a technical team develo … cessful result
- Translate user needs into req … ll that users will like the outcome
- Design and build something … to your design specifications
- Grasp the concept and limits … to see the best ways to use it
- Develop your own origi … test it
- Understand exactly wha … aking theoretical article
- Convince a customer or … t time
- Convert a useful scientif … n
- Recruit the right emp …
- Recognize when an i … ess venture
- Work with a supplier … successful
- Write a clear and com …
- Estimate accurate …
- Pick the right mar … ice
- Know the steps ne … venture
- Oral and written c …
- Basics of finan …
- Teamwork
- Creativity and …
- Real-time strat …
- Comfort wit …
- Risk-taking
- Evangelism, … asion



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