Bloom’s Taxonomy, Educational Objectives, Outcomes, and our Friends from ABET
- An Engineering Case Study-

Information collected by
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Overview

- Bloom’s Taxonomy
  - Some background information
  - Relationship to Engineering Education
- Educational Objectives
- Educational Outcomes
- Our friends at ABET
  - ABET is not a four letter word
  - What is it all about?
  - How do you fit in?
Bloom’s Taxonomy

- More than one type of learning—3 domains
  - **Cognitive**: development of intellectual skills
  - Affective: manner in which we deal with things emotionally (feelings, values, attitudes)
  - Psychomotor: physical movement, coordination, motor-skill areas

- Bloom developed taxonomy (hierarchy) of **Cognitive** learning skills
  - “Allows educators to evaluate learning of students systematically [Bloom, 1994]”
Bloom’s Taxonomy of Cognitive Learning Skills

Knowledge
Comprehension
Application
Analysis
Synthesis
Evaluation

Higher Thought Processes
Bloom’s Taxonomy

- Knowledge: repeating verbatim
  - List
  - State
- Comprehension: demonstrating understanding of terms and concepts
  - Explain in your own words
  - Interpret
- Application: applying learned information to solve a problem
  - Calculate
  - Solve

Higher thought processes
Bloom’s Taxonomy

- **Analysis**: breaking things down into their elements, formulating theoretical explanations or mathematical or logical models for observed phenomena
  - Derive
  - Explain
- **Synthesis**: creating something, combining elements in novel ways
  - Formulate
  - Make up
  - Design
Bloom’s Taxonomy

- Evaluation: making and justifying value judgments or selections from among alternatives
  - Determine
  - Select
  - Critique
Bloom’s Update – 1990’s

Bloom 1956

- Knowledge
- Comprehension
- Application
- Analysis
- Synthesis
- Evaluating

Anderson et al -1990’s
- Bloom’s student
- noun to verb

from: http://www.odu.edu/educ/roverbau/Bloom/blooms_taxonomy.htm
Creativity is very important for the engineering profession [Goel, 2004]

Creativity requires higher thought processes (Bloom items 4-6: Analysis, Synthesis, Evaluation) [Felder et al., 2004]

In many cases lectures and homework assignments focus exclusively on Bloom item 3: Application [Felder et al., 2004]

“Then, if they put a high-level question on exam and the students do poorly on it, they blame the students’ lack of ability or poor study habits.”

Need to include high-level tasks in learning (educational) objectives
Application to Engineering Education

- Need to develop high level tasks
  - Include high-level tasks in learning objectives
  - Share them with students
  - Practice them in class
  - Practice via assignments
  - Test on examination

- Let’s take a closer look at objectives…
Educational Objectives

- Characteristics of graduates a few years after graduation
  - Difficult to assess and measure

- The Program Educational Objectives for the Electrical Engineering Program are:
  - (EE-OB1) Be able to successfully practice the profession of Electrical Engineering.
  - (EE-OB2) Be prepared and motivated to accept challenging assignments and responsibilities and be productive members of society.
  - (EE-OB3) Demonstrate successful career growth (e.g., professional registration, graduate school, promotion and advancement, patents, publications).
Student Outcomes -- measurable student characteristics at graduation

Student outcomes are outcomes (a) through (k):
(a) an ability to apply knowledge of mathematics, science, and engineering
(b) an ability to design and conduct experiments, as well as to analyze and interpret data
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
(d) an ability to function on multidisciplinary teams
(e) an ability to identify, formulate, and solve engineering problems
(f) an understanding of professional and ethical responsibility
(g) an ability to communicate effectively
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
(i) a recognition of the need for, and an ability to engage in life-long learning
(j) a knowledge of contemporary issues
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
Course Objectives -- Your individual course objectives support the department’s educational outcomes and objectives

Course objectives EE4490 Hardware Descriptive Language (HDL):
Students shall:
- (PO-1) Demonstrate knowledge about the target hardware for an HDL
- (PO-1) Demonstrate an understanding of the fundamentals for an HDL
- (PO-1) Demonstrate an understanding and application of State Machine diagrams
- (PO-2) Implement digital design concepts from EE 2390 with an HDL
- (PO-4) Demonstrate an ability to take an algorithm from design specification to HDL implementation
- (PO-4) Demonstrate an ability to create testbenches to validate correct operation of HDL implementation
- (PO-4) Demonstrate an ability to correct and improve upon faulty HDL code
- (PO-5) Demonstrate the ability to use HDL tools correctly
- (PO-6) Be expected to submit assignments that clearly indicate an understanding of the lecture concepts, and provide HDL code that is easy to follow
- (PO-11) Do their own work, and submit design results that are consistent.
ABET/EAC/CAC

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  - ABET is not a four letter word 😊
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- ABET/EAC – Accreditation Board for Engineering and Technology, Inc./Engineering Accreditation Commission
  - Accredits engineering programs
  - UW College of Engineering had onsite visit in September 2003
  - Received ongoing accreditation/initial accreditation for engineering programs
  - Onsite visit Oct 24-27, 2015
What is it all about?

- Constituents
- EC2000
- University and College Guidance
- Department Objectives, Outcomes
- Curricula
- Faculty
- "Moving Forward", report cards
- Data collection, analysis, and interpretation
- Feedback for improvement
- Advisory boards
- Long term loop
- Short term loop
- Feedback to administration
- Curriculum improvements
How do you fit in?

University of Wyoming **Mission** Statement

College of Engineering **Mission** Statement

Department of Electrical and Computer Engineering Program **Objectives**

Department of Electrical and Computer Engineering Program **Outcomes**

Department of Electrical and Computer Engineering Curricula:
  - Electrical Engineering **Curriculum**
  - Electrical Engineering Curriculum/Bioengineering Option
  - Computer Engineering **Curriculum**

**Course Objectives** -- characteristics of students at the time of course completion
Summary and Conclusions

- Use Bloom’s Taxonomy to properly scope objectives
- Teach and assess at appropriate levels of the taxonomy
- Your individual course objectives support the mission of your department, college, and the university
  - Use Bloom’s Taxonomy to properly scope, teach, and assess course objectives
- ABET is everybody’s business!
References

- S. Goel, “What is High About Higher Education?” The National Teaching and Learning Forum, Volume 13, Number 4, 2004