Design

What is it?
How to do it?

How and why is it related to Bloom’s Taxonomy?

Reflections on Design and design Cycles

CprE EE SE 491
Last modified Sp2017
What is design?

• It is not a linear process
• It is not something that will end, we keep thinking about it
• It is not something that we can create by just hard work, and putting many many hours on it
• It takes researching, planning, thinking, iterations, mistakes, revisiting,
• It is focused by specifications
  – Specifications
  – Deliverables
  – ..
Is a plan and a process!

- Like any other plans it changes
- Like any other process, it fails at times
- Know the big picture (but it is also true for all modular pieces of the process)
  - What do we want to do?
  - What are the objectives?
  - What are the specifications?
  - What are the required things?
  - How do we test our results?
Engineering Design

• The **engineering design process** is the formulation of a plan to help an engineer build a product with a specified performance goal. This process involves a number of steps, and parts of the process may need to be repeated many times before production of a final product can begin.

http://en.wikipedia.org/wiki/Engineering_design_process
The Engineering Design Process

1. **ASK**
   - What are the Problems?
   - What are the Constraints?

2. **IMAGINE**
   - Brainstorm Ideas
   - Choose the Best One

3. **PLAN**
   - Draw a Diagram
   - Gather Needed Materials

4. **CREATE**
   - Follow the Plan
   - Test it Out!

5. **IMPROVE**
   - Discuss What Can Work Better
   - Repeat Steps 1-5 to Make Changes

[Image: http://www.engr.ncsu.edu/theengineeringplace/media/graphics/design-process.png]
The engineering design process involves a series of steps that lead to the development of a new product or system. In this design challenge, students are to complete each step and document their work as they develop their lunar plant growth chamber. The students should be able to do the following:
Engineering Design Process

1. Identify the Problem
2. Identify Criteria & Constraints
3. Brainstorm Possible Solutions
4. Generate Ideas
5. Explore Possibilities
6. Select an Approach
7. Build a Model or Prototype
8. Refine the Design

Engineering Design Process

Identify

Brainstorm

Choose

Design

Test

Redesign

Show
The Engineering Design Process...

1. Identify need or problem
2. Research need
3. Develop possible solutions
4. Select best solution
5. Construct a prototype
6. Test & Evaluate
7. Present solution
8. Redesign

...can be used to solve ANY type of problem

You are an engineer

Engineering Design Process

www.theworks.org
What is design?

• The design process is an optimization process:
  • Given an objective (possibly multiple objectives), and
  • Given a set of constraints, e.g., economic, environmental, regulatory, etc.
  • Implement a system that optimizes the given objectives while satisfying the constraints

• The design process is mostly an iterative process
• The design process is part of the product life-cycle
Design, innovation, creativity,.......how are these all related?

Why does ABET accreditation board emphasizes the design experience?
Bloom Taxonomy

• Engineering education in perspective
• Where would design fit for you in your education?
• Let us look at some systems level thinking about education
• The question they asked:
  How can we train people to work, modify, maintain, and design highly complex systems?
Bloom's Taxonomy
learning and development

• Refers to a classification of the different objectives that educators set for students (learning objectives).

• Bloom's Taxonomy divides educational objectives into three "domains": Cognitive, Affective, and Psychomotor
  – (sometimes loosely described as knowing
  – head, feeling
  – heart and doing/hands respectively).

• Within the domains, learning at the higher levels is dependent on having attained prerequisite knowledge and skills at lower levels. A goal of Bloom's Taxonomy is to motivate educators to focus on all three domains, creating a more holistic form of education.

http://en.wikipedia.org/wiki/Bloom's_Taxonomy
What is it?

• In 1956, Benjamin Bloom headed a group of educational psychologists who developed a classification of levels of intellectual behavior important in learning. During the 1990's a new group of cognitive psychologists, lead by Lorin Anderson (a former student of Bloom), updated the taxonomy to reflect relevance to 21st century work. The two graphics show the revised and original Taxonomy. Note the change from nouns to verbs associated with each level.

http://ww2.odu.edu/educ/roverbau/Bloom/blooms_taxonomy.htm
BLOOM'S REVISED TAXONOMY

Higher-order thinking

Creating
Generating new ideas, products, or ways of viewing things
Designing, constructing, planning, producing, inventing.

Evaluating
Justifying a decision or course of action
Checking, hypothesising, critiquing, experimenting, judging

Analysing
Breaking information into parts to explore understandings and relationships
Comparing, organising, deconstructing, interrogating, finding

Applying
Using information in another familiar situation
Implementing, carrying out, using, executing

Understanding
Explaining ideas or concepts
Interpreting, summarising, paraphrasing, classifying, explaining

Remembering
Recalling information
Recognising, listing, describing, retrieving, naming, finding
Creating
- The student can put elements together to form a functional whole, create a new product or point of view: assemble, generate, construct, design, develop, formulate, rearrange, rewrite, organize, devise.

Evaluating
- The student can make judgments and justify decisions: appraise, argue, defend, judge, select, support, evaluate, debate, measure, select, test, verify

Analyzing
- The student can distinguish between parts, how they relate to each other, and to the overall structure and purpose: compare, contract, criticize, differentiate, discriminate, question, classify, distinguish, experiment

Applying
- The student can use information in a new way: demonstrate, dramatize, interpret, solve, use, illustrate, convert, discover, discuss, prepare

Understanding
- The student can construct meaning from oral, written, and graphic messages: interpret, exemplify, classify, summarize, infer, compare, explain, paraphrase, discuss

Remembering
- The student can recognize and recall relevant knowledge from long-term memory: define, duplicate, list, memorize, repeat, reproduce

https://prezi.com/m7z8epdluxd_/blooms-taxonomy/
Resources at ISU

• At ISU
  http://www.celt.iastate.edu/teaching/effective-teaching-practices/revised-blooms-taxonomy

• Cool responsive site
  http://www.celt.iastate.edu/teaching/effective-teaching-practices/revised-blooms-taxonomy/revised-blooms-taxonomy-flash-version