The Engineering Learning Process
from Three Perspectives: Designer, Facilitator, and Learner

**Step 1**

**Purpose (LPM Step 1: why)**
- a. What is going to be learned?
- b. Why is this knowledge important to the big picture of the course/discipline?
- c. How does this knowledge connect with other related knowledge? *(LPM Step 2: orientation)*
- d. Why is this knowledge relevant to the learner’s life?

**Step 2**

What do we do to approach this learning (essential core) like a mathematician with the discovery and creativity to make it interesting, intriguing, and fun? *(i.e., play with the engineering)*
- a. Find an interesting context relevant to the learner(s) *(Who Gives a Darn?)* *(Step 1 LPM)*
- b. Make it discovery-oriented *(Step 2 LPM: orientation)*
- c. Add creativity and new insights to the discoveries
- d. Engage in learning that mirrors the Engineering mindset

**Step 3**

Expectations for the learning performance *(LPM Step 4: learning objectives & LPM Step 5: performance criteria)*
- a. What are the learning objectives?
- b. What are the expected performances, and associated tasks, that the learner must be able to do by the end of the learning experience?
- c. What specific performance criteria are going to be used for measuring the quality of this performance?
- d. The description of the expected level of performance should allow the learner or facilitator to determine the degree of success.

**Step 4**

What do you already know? *(LPM Step 3: pre-requisites)*
- a. What previous life experiences can you bring forward to this new learning?
- b. What previous knowledge of prior courses can you take advantage of?
- c. What can you bring forward from the discovery exercise?
- d. What can you look forward to in the current reading that you can utilize?
- e. What can you look for and analyze in the presented models?

**Step 5**

Required engineering language *(the precision of its terminology, symbolic representations and Engineering notation)* *(LPM Step 6: Vocabulary)*
- a. Identify previous Engineering language that is going to be used
- b. Introduce new representations
- c. Introduce new associated tool(s) and Engineering conventions
- d. Introduce the terminology for each of the new engineering ideas/concepts

**Step 6**

Information needed before (reading assignment) and during the learning experience *(LPM Step 7: Information)*
- a. Describes briefly the key concepts and big ideas
- b. Identifies valuable internet sites or books for exploring and reading
- c. Provides unique resources and expertise for the learning
  - Methodologies
    - Steps with discussion
    - Worked out example(s)
    - Opportunity for learner to try out their own example
  - Table of Tips or Insights in contextualizing
  - Common Errors with specific content
  - Visuals and diagrams representing unique perspective

**Step 7**

Learning resources *(LPM Step 7 Information and Resources)*
May include: Software tools, Manipulatives, Simulations, Learning Objects, Data sets
### Step 8
Are you Ready? *(LPM Step 8: Plan)*
- a. Validate what is known after performing Engineering Learning Process Steps 1 – 6
- b. Document this learning with answers to Exploratory Questions and/or reading quiz
- c. Document what is not known with a set of questions ready to be investigated in class
- d. Identify the key learning challenges contained within this knowledge
- e. Planning how the learner will meet the challenges; putting together a plan with specific steps

### Step 9
Classroom activity
- a. Summarize and review Steps 1 – 7 of the LPM
  - Why *(LPM Step 1)*
  - Learning Objectives *(LPM Step 4)*
  - Performance and Criteria *(LPM Step 5)*
  - Critical Information for the activity *(LPM Step 7)*
- b. Plan *(LPM Step 8)* connects pre-activity of the experience to the classroom experience, including specific tasks such as sub-activities to increase understanding related to Critical Thinking Questions (see d, below)
- c. Models *(LPM Step 9)*
- d. Critical Thinking Questions *(CTQ) (LPM Step 10)*

### Step 10
Demonstrate Your Understanding *(LPM Step 11)*
- Start with familiar context
- Move into a less familiar context
- Challenge learner to transfer to an unfamiliar context
- Limit the additional challenges to three with the focus on generalizing

### Step 11
Hardest Problem: Generalizing the knowledge *(continuation of LPM Step 11)*
- a. Identify the variations that can be included in the problem that would complicate solving it
- b. Create a problem that challenges all these dimensions
- c. Think through to make sure that you can address all the dimensions even when they change
- d. Test the boundary conditions for validity
- e. Explore possible and appropriate contexts for use of this knowledge based upon valid contextual prompts, issues, and boundaries

### Step 12
Making it Matter: Problem Solving *(LPM Step 12)*
- a. Explore situations that require the use of this knowledge along with previous knowledge
- b. Pick contexts or situations that are meaningful for the learner
- c. Set the level of challenge presented in the problem to require the use of the problem solving methodology but not so difficult that it would require research process
- d. Learner must identify meaningful contexts so they can own and solve relevant problems
- e. Focus on Step 9 of PSM to see how these problem solutions can be reused in new situations

### Step 13
Identify and Correct the Errors *(LPM Step 13: a focus on content)*
- a. Assess the learning: knowing you know what you know
- b. Shift from nearly clear to crystal clear by finding out others’ errors in thinking
- c. Validate learning by using at least one validation technique

### Step 14
Learning to Learn Engineering *(LPM Step 13: focus on discipline process)*
- a. Target areas of Learning Engineering to reflect on
- b. Explore the Engineering Professionalism and Mindset connected with the content
- c. Identify ways to help the growth of the learner, i.e., improving learning skills connected with the Engineer Learner Profile

### Step 15
Assess Learning Performance *(LPM Step 13: focus on the Engineering Learning Process)*
- Use the target of the learning challenge (Performance and Criteria) for self-assessment of effectiveness and efficiency of learning performance
- Recognize strengths produced and how they were produced
- Identify improvements with specific action plans
- Develop new understanding about Engineering learning process and learning performance