Preparing First-Year Students for Academic and Career Success

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A Quick Roadmap

• An introduction to first-year engineering
• What are career & academic skills?
• Teamwork activity
• A sample topic, how we structure it, and how you might apply a similar structure in your class
• An example of a process structure we weave through the course, and how you might do something similar
• Your applications
The Real Stars of the Presentation

Two of our very finest FEH TAs:

Max Kross
Drew Phillips
First-Year Engineering Honors

• Open to any first-year student who
  – Is University-designated honors
  – Chooses an engineering pre-major

• Two-semester sequence in engineering fundamentals to help students
  – Determine if engineering is for them
  – If so, identify a potential major discipline
  – Regardless, develop effective academic skills

Preparing for Academic & Career Success
Activity Time!

• Get into a group of 3 or 4.
• Quickly introduce yourselves.
What Skills Do Our Students Need to Succeed?

The ability to

• function on multidisciplinary teams
• apply content knowledge to solving problems
• engage in life-long learning

(paraphrased from ABET)
Activity – Part 1

• You have 4 minutes to answer as many items on the puzzle as you can.
• You may use:
  – Your brain
• IN SILENCE, count how many items you have a reasonable answer for.
• Write this number in the lower left of your paper.
Activity – Part 2

• IN SILENCE, choose a member of your group to be the record keeper.
• We will count from 1 to 25. When we say the number of an item that you have an answer for, raise your hand.
• The record keeper will tally how many items someone on the team has an answer for.
• Each member of the team should write that number in the middle bottom of the page.
Activity – Part 3

• Take 4 minutes to discuss and get as many more items answered as you can.
• Tally the number of items you have answers for now.
• Write this number in the lower right corner.
So, Why Did We Do This?

• There are many correct answers!
• Some possibilities:
  – Teamwork requires a worthy task.
  – Different people see different connections (aka, diversity is good!)
  – Teamwork is more than adding individual results together.
  – Knowing who is responsible for what can aid efficiency and effectiveness

Preparing for Academic & Career Success
Problem Solving Method

1. Define
2. Represent
3. Plan
4. Implement
5. Evaluate

Note: At any step you may have to go back to a previous step, even back to the beginning.

SOLUTION
In the Same Class: Sample Problem

- Determine how much paint you need to purchase to apply two coats of paint on a 16ft x 20ft room that has a 10ft ceiling height.
1. Define

- Do you understand the problem completely?
  
  **Tasks:**
  - Restate the problem and clearly identify the goal.
  - Document the information you know or have been given, as well as, the information you need to figure out.
  - Identify and document the constraints or limitations on the solution (i.e., cost, time, materials).
  - Document initial assumptions or estimates for parameters needed based on the information you need to figure out.
Define our sample problem

Identify Goal:
Determine the number of gallons of paint needed to paint the room.

Given:
- Length: 16 ft
- Width: 20 ft
- Height: 10 ft

TBD:
- Are the doors and ceiling included? Do they require the same type of paint?
- How many doors or windows are in the room?
- What are the dimensions of windows and doors?
Define our sample problem (cont.)

Identify Constraints:
• Two coats of paint are required.

Make Assumptions/Estimates/Research:
• The painting job will not include the ceiling.
• Doors are not to be painted.
• There are 2 doors and 2 windows.
• Size of doors and windows
• Coverage of paint
Define our sample problem (cont.)

• Assumptions for doors/windows:
  – Door dimensions: 7 ft x 3 ft
    • $A_{\text{door}} = 21 \text{ ft}^2$ per door
  – Window dimensions: 3 ft x 5 ft
    • $A_{\text{window}} = 15 \text{ ft}^2$ per window

• Assumption for coverage
  – Coverage$_{\text{paint}} = 320 \text{ ft}^2$ per gallon
2. Represent

• Change the problem into a form that makes it easier to understand. Generally, that can be easiest with some form of visual aid.
  – Sketch
  – Graph
  – Flowchart
  – Diagram
Represent our sample problem

Ceiling height = 10 ft.
3. Plan

- Utilize representation to identify **underlying principles** that can be used to solve the problem.
- Recognize possible similarities and differences with previously encountered problems.
- Identify potential tools to be used.
- If required, make additional assumptions/estimates.
- Consider if assumptions are valid/acceptable.
Plan our sample problem

- **Identify Underlying Principle:**
  - Geometry (area calculations) and rate(coverage) problem!

- **Recognize Possible Similarities and Differences:**
  - Area Calculations: Determine paintable surface area.
  - Paint Coverage: Calculate how many gallons of paint needed.

\[
Area = \text{length} \times \text{width} \\
A_{\text{paint}} = A_{\text{walls}} - A_{\text{windows}} - A_{\text{doors}} \\
\text{Gallons of Paint} = \text{Coats} \times \frac{A_{\text{paint}} (ft^2)}{\text{Coverage} (\frac{ft^2}{gal})}
\]
• Additional assumptions/estimates made:
  – Assumed, estimated, or measured:
    \[ A_{\text{door}} = 21 \text{ ft}^2 \text{ per door} \]
    \[ A_{\text{wind}} = 15 \text{ ft}^2 \text{ per window} \]
    \[ \text{Coverage}_{\text{paint}} = 320 \text{ ft}^2 \text{ per gallon} \]
  – Identify potential tools to be used.
    Calculator, spreadsheet, pencil, iPhone app, etc.
4. Implement

- Execute the plan.
- Perform dimensional analysis.
- Display all results in an appropriate, well-labeled tabular or graphical format.
Implement our sample problem

• Execute Plan

\[ A_{paint} = A_{walls} - A_{windows} - A_{doors} \]

\[ A_{paint} = [(2 \times h_{wall1} \times l_{wall1}) + (2 \times h_{wall2} \times l_{wall2})] - (2 \times A_{window}) - (2 \times A_{door}) \]

\[ A_{paint} = [(2 \times 10\text{ft} \times 16\text{ft}) + (2 \times 10\text{ft} \times 20\text{ft})] - (2 \times 15\text{ft}^2) - (2 \times 21\text{ft}^2) \]

\[ A_{paint} = 648 \text{ ft}^2 \]
Implement our sample problem (cont.)

\[
\text{Gallons of Paint} = \text{Coats} \times \frac{A_{\text{Paint}} \ (ft^2)}{\text{Coverage} \ (\frac{ft^2}{gal})}
\]

\[
\text{Gallons of Paint} = 2 \times \frac{648 \ ft^2}{320 \ \frac{ft^2}{gal}}
\]

Gallons of Paint = 4.05 gallons
5. Evaluate

• Ask
  – Does the solution make sense?
  – Does the solution answer the original question?
  – Are the units correct and reasonable?
  – Can other approaches be used to check the calculations?

• Present the solution, clearly identifying constraints and assumptions that were used.
Evaluate our sample problem

- **Ask questions:**
  - Does 4.05 gallons of paint make sense?
  - Does 4.05 gallons of paint answer the original problem?
  - Are the units appropriate?
  - What about lost/wasted paint?
  - Is the paint coverage rate reasonable? What did it include? (type of surface, etc.)
• Can we use other approaches involving the same variables to verify our calculations?
• CHECK - What was the method used for the first calculation?
Evaluate our sample problem (cont.)

\[ \text{Length}_{\text{walls}} = 16\text{ft} \times 2 + 20\text{ft} \times 2 = 72\text{ft} \]
\[ \text{Area}_{\text{walls}} = 72\text{ft} \times 10\text{ft} = 720\text{ft}^2 \]
\[ \text{Area}_{\text{doors/windows}} = 15\text{ft}^2 \times 2 + 21\text{ft}^2 \times 2 = 72\text{ft}^2 \]
\[ \text{Gallons}_{\text{paint, one coat}} = \frac{720\text{ft}^2 - 72\text{ft}^2}{320\text{ft}^2/\text{gal}} = \boxed{2.025 \text{ gal}} \]
\[ \text{Gallons}_{\text{paint, two coats}} = 2 \times 2.025 \text{ gal} = \boxed{4.05 \text{ gal}} \]

Number of gallons to be purchased: 5 gallons
Present the solution

A total of 5 gallons of paint will be purchased to provide two coats to the walls of the room given the assumptions listed previously.
Using the problem solving strategy discussed in class, calculate the cost of the concrete needed to construct a six-lane highway between Oklahoma City, OK and Albuquerque, NM.

Take the following into consideration:
- Don’t forget to consider geographical and topographical constraints.
- Assume concrete costs $80 per yd\(^3\).
- Assume rebar occupies 4% of the volume of the ‘concrete’ in the highway.

Typical highway cross section:

You must demonstrate and fully document all stages of the problem solving strategy discussed in class. Label the portion of the solution pertaining to each stage with the appropriate stage name. This may be done by hand or using a computer, as long as it is neat and legible.
Problem Statement

...You want to create a program to count down the days between now and the end test date.... A start date of 9/17/2013 and an end date of 9/18/2013 should have an answer of “1 day remaining.”

For the purposes of this assignment assume all full years have 365 days, and all additional months in a partial year have 30 days.
Instructions

Represent:
Create a flowchart, algorithm, or pseudocode to represent your solution process.

Plan:
Create a script file.
Outline the steps your program will take by adding comment statements to your script file based on your flowchart, algorithm or pseudocode.
Implement:

In the script file, perform the following tasks:

– Prompt the user to enter the test name as a string.

– Prompt for the current date (month, day & year).

– Prompt for the future date for the end of the test.

– Compute the number of days between the current and future date.

– Display to the screen the test name, the current and future dates (in numbers), & the number of days until the end of the test.
Evaluate:

Check your answer with another source. One source is the website http://www.timeanddate.com/countdown/create

However, keep in mind that your answer may vary due to month sizes and leap years.
There is no Escaping DR. PIE!

- Every daily assignment is structured in this way.
- Staff is trained to insist on the DR. PIE approach.
- There are explicit questions about DR. PIE on a midterm and the final exam.

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Define the questions
Represent your responses
Plan the statistics
Implement an awesome video
Evaluate how you did!
Reflection

• Think about a class you teach where there are repeated processes that students resist.
• Could you use elements of this structure to aid students in developing the approach (or at least some of the approach) you want?
• Jot down a few notes for later in the session.
The inverted, or flipped, classroom.

What thoughts come to your mind when you hear this?
# Inverted Classroom Structure

<table>
<thead>
<tr>
<th>Before Class</th>
<th>During Class</th>
<th>After Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preparation activity</td>
<td>Short lecture</td>
<td>Finish application assignment(s)</td>
</tr>
<tr>
<td>Evaluation</td>
<td>Activities</td>
<td>Prepare for next class</td>
</tr>
<tr>
<td></td>
<td>Application assignment(s)</td>
<td></td>
</tr>
</tbody>
</table>
Sample Preparation

Preparation for Class 12 - MATLAB - Input & Output

• Read MATLAB book pages 95-107.
• Watch the video: MAT_Input_OutputVIDEO
• Take the associated quiz on Carmen.
You Should Know & Understand

• Variables and MATLAB's workspace
• What the ; symbol is used for at the end of a line
• How to assign variables
• How to use the input() command
• How to use the disp() command
• How to use fprintf() to print to the screen
• How to format output
% Prompt the user to enter their name using the input() command
name=input('Enter name: ', ______________);

% Prompt the user to enter their age
age=input(__________________);

% Write the name and age to the screen using fprintf()
fprintf('
Your name is __________________)
fprintf('
Your age is __________________)
Concept Comprehension

PRE B12-1 2014
Understand the Best

- Variables and MATLAB's Workspace
- What the ; symbol is used for at the end of a line
- How to assign variables
- How to use the input() command
- How to use the disp() command
- How to use fprintf() to print to the screen
- How to format output

PRE B12-1 2014
Questions

- Variables and MATLAB's Workspace
- What the ; symbol is used for at the end of a line
- How to assign variables
- How to use the input() command
- How to use the disp() command
- How to use fprintf() to print to the screen
- How to format output
Character Input #1 – `input()`

- prompt flag – `'s'`
- script file waits
- response assigned to `x`

```matlab
...  
x = input('Muffin? ', 's');  
...  
>> script_04  
Muffin?  Yes
```
Reflection

• Think about a class you teach where you would like students to take on more responsibility for their learning.

• Think of a topic very early in the course that might be appropriate for “flipping.” How might you use elements of the structure we shared?

• Jot down a few notes.
Time for You to Work!

• Form groups of 3-4 to work on either process structuring or inversion.
• In your group, discuss the following:
  – What are the essential elements of the structures we shared with you?
  – Why do they seem to be important?
  – Do you think modifications might be needed for your student population?
• Summarize your thoughts on the paper provided.

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Next Assignment

• Think about your course and what this structure might look like there.
• Make a rough outline of how you would put it together.
• Write down any questions/concerns you have about the approach.
• Share with your group.
• Summarize your discussion on the paper.
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Preparing for Academic & Career Success
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First-Year Engineering Outcomes

By the end of their first year, our students:

• Are prepared for advanced engineering courses
• Know what "flavor" of engineering they like
• Have personal and professional skills required to become successful engineers
• Are connected to faculty and the engineering profession
• Are genuinely excited about engineering