From Problem Set to Design Proposal: Fostering Discipline-Relevant Writing (and Writing Instruction) in Mechanical Engineering

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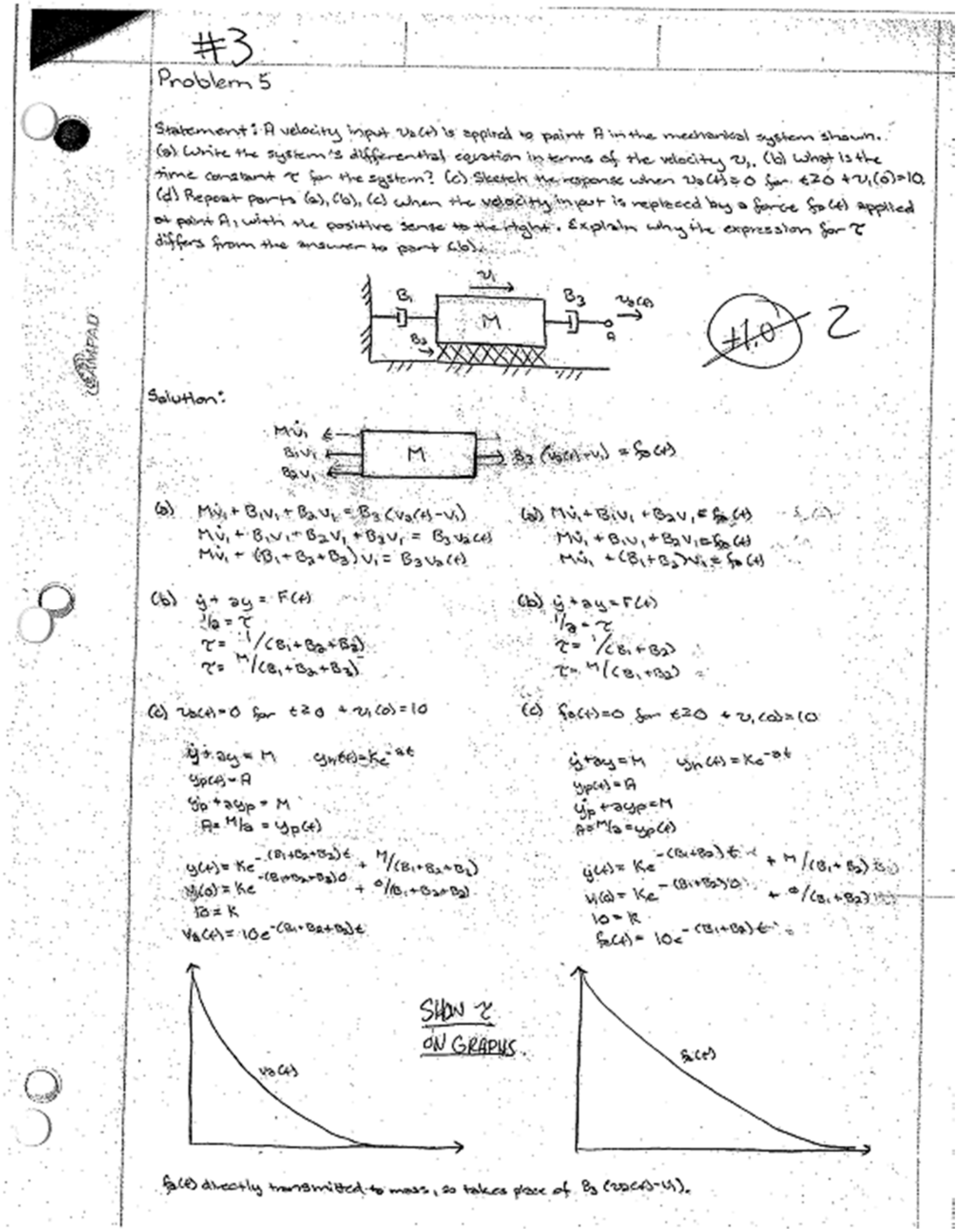
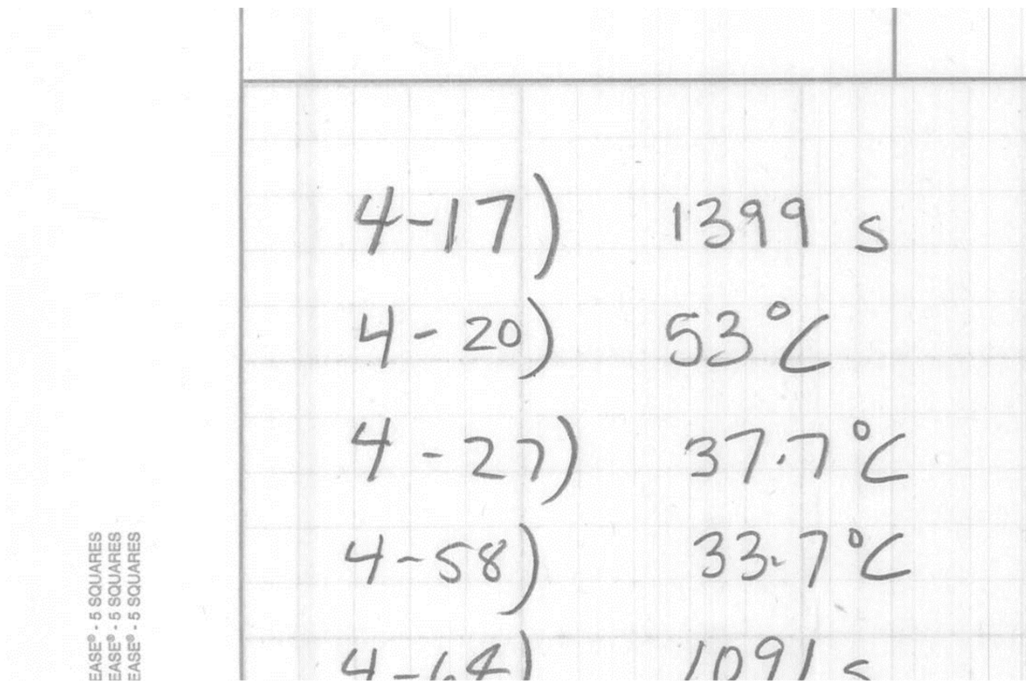
What does Mechanical Engineering writing look like?



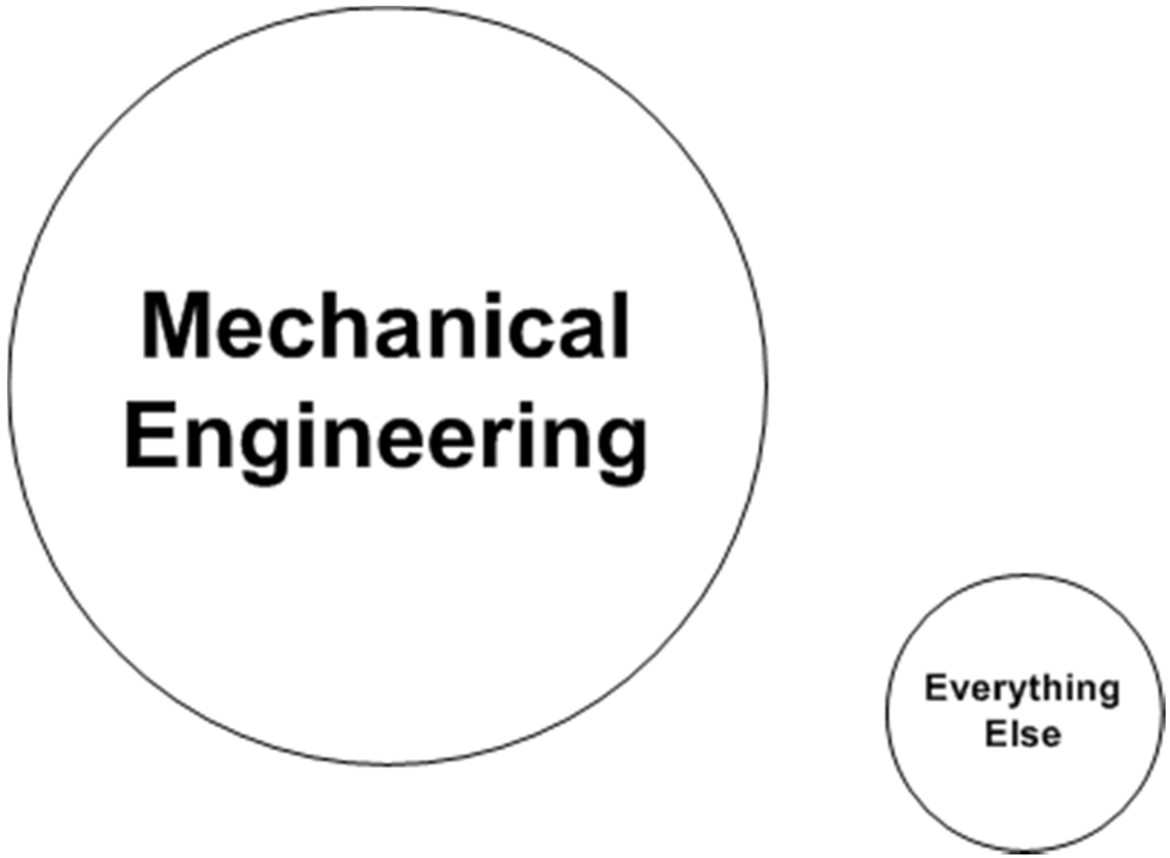
We need writing.

It is as much a process as a product.

But students think this is OK



WI isn't quite enough



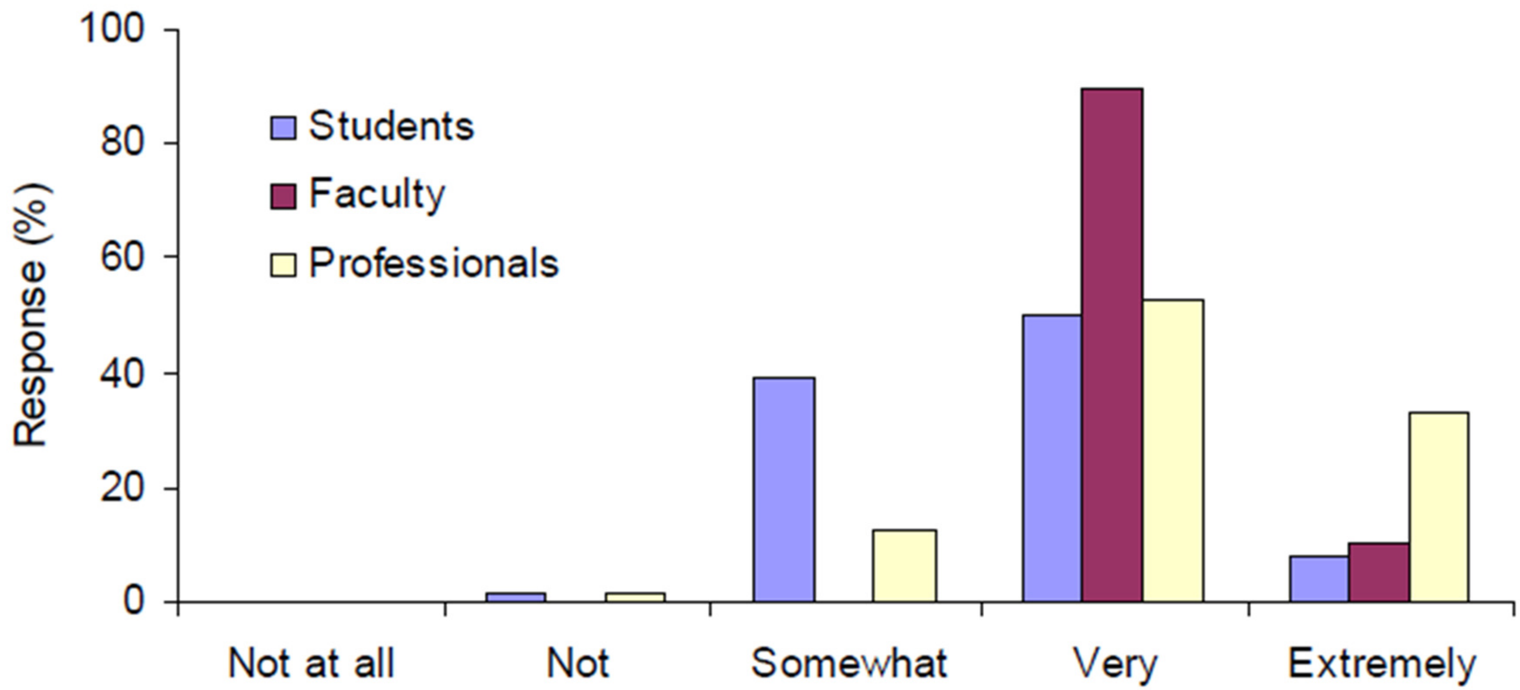
2007 Survey: Faculty didn't consider problem sets as writing.

Faculty: How many pages of individual student writing, on the average, do you assign per course?

Response	Percent
0 Pages	7%
1-5 Pages	14%
6-10 Pages	35%
11-20 Pages	14%
21-50 Pages	7%
51-100 Pages	7%
100+ Pages	14%

"[Prof] Durfee stated that if problem sets had been included on the survey, 100% of students and faculty would have identified them." –M1 meeting minutes

2007 Survey responses to the importance of writing in Mechanical Engineering



Sample Sizes

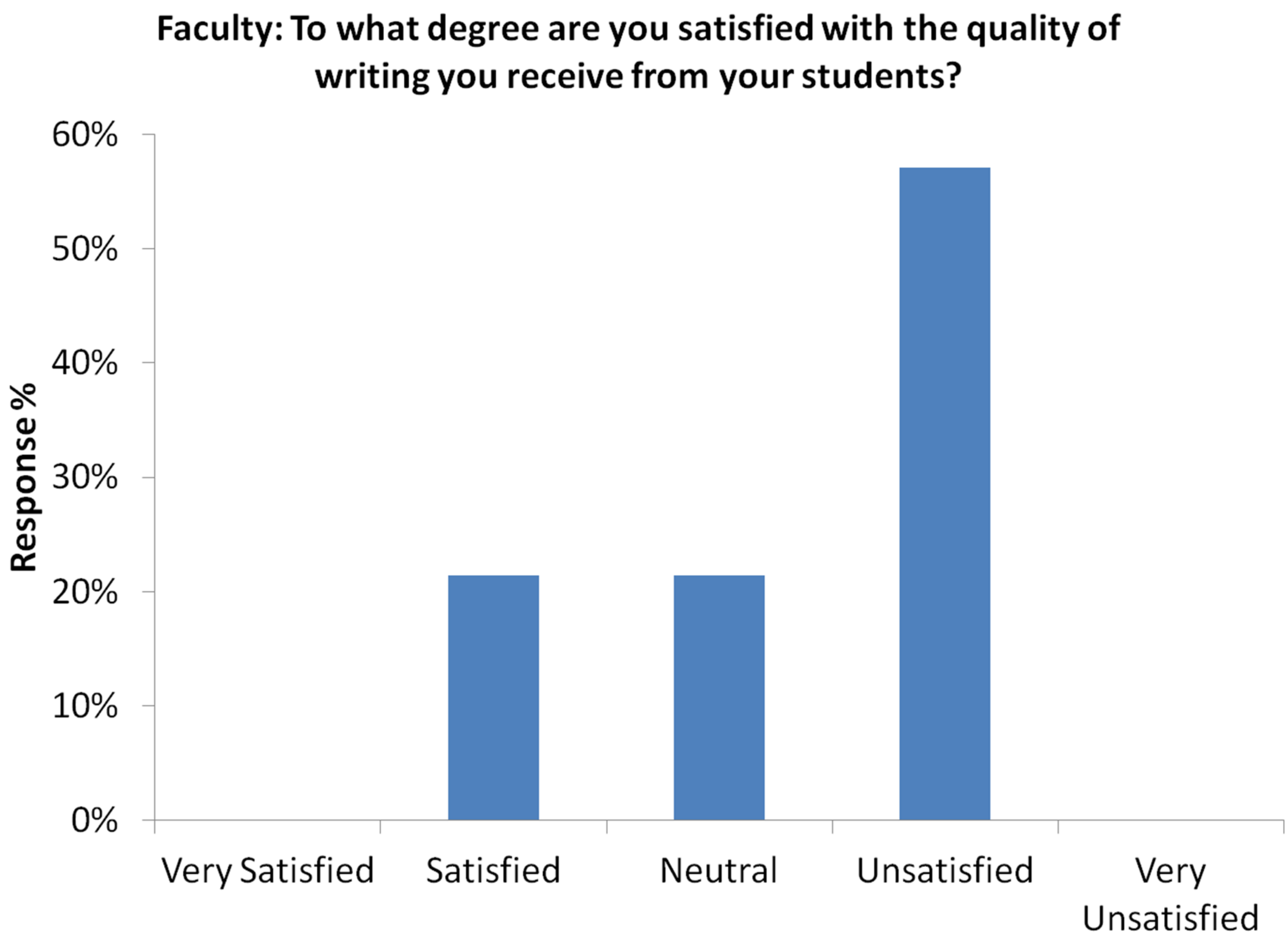
Students (N=70)

Faculty (N=15)

Professionals (N=11)

Survey by: Pamela Flash & Leanne Kastman-Breuch

2007 Survey: How are students doing?



2007 Survey: Please describe the most serious problems you see in student writing.

Students say:

- Maintaining coherence or “flow”
- Organizing ideas
- Using proper word choice

Faculty say:

- Creating an argument
- Organization
- Summary writing
- Audience Analysis
- Grammar, punctuation, spelling, mechanics

2007 Survey: Final Words

Faculty

"I would prefer if somebody else would do the teaching of writing."

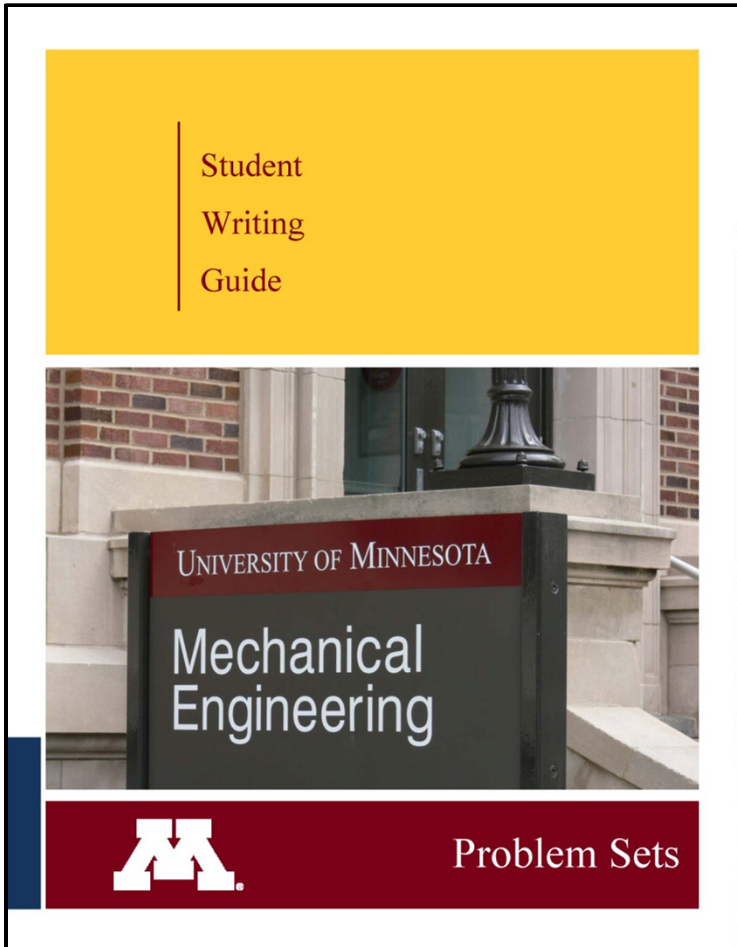
"Will need support for any of this."

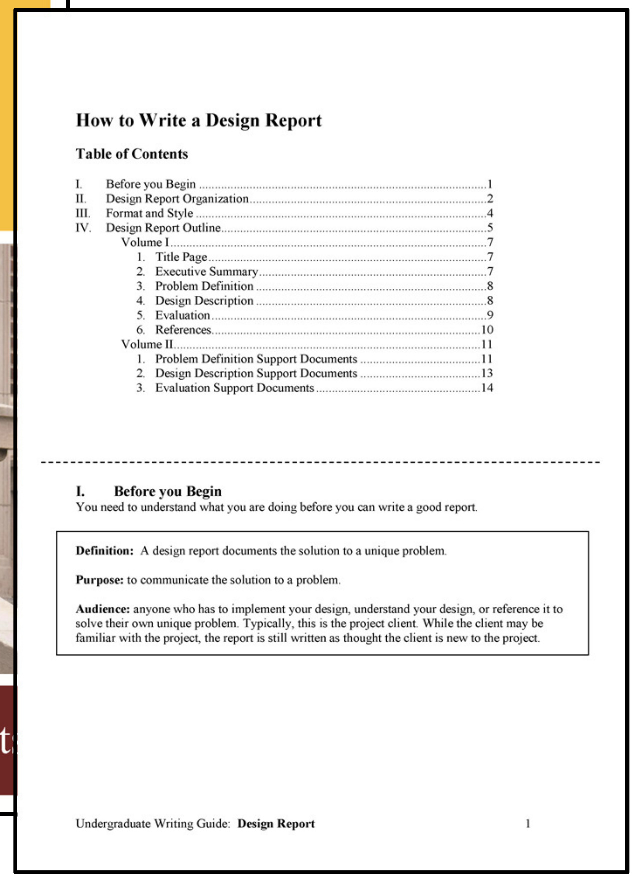
Students

What resources would be helpful to you?

Specific writing guidelines	**57%**
Face-to-face tutoring	41%
Support from graduate TAs	39%
Instructor office hours	38%

The Result





How to Write a Design Report

Table of Contents

I. Before you Begin
You need to understand what you are doing before you can write a good report.

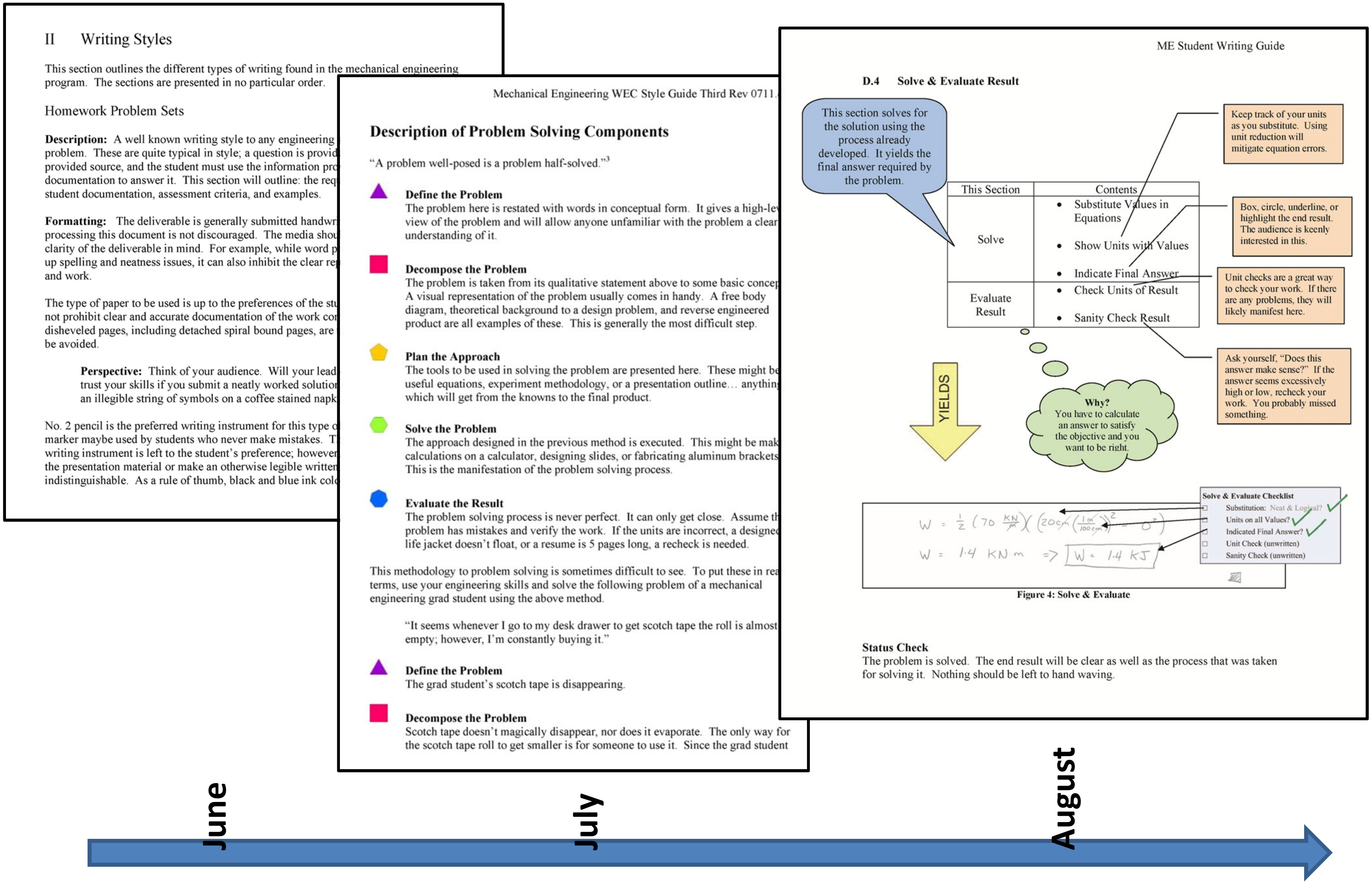
Definition: A design report documents the solution to a unique problem.

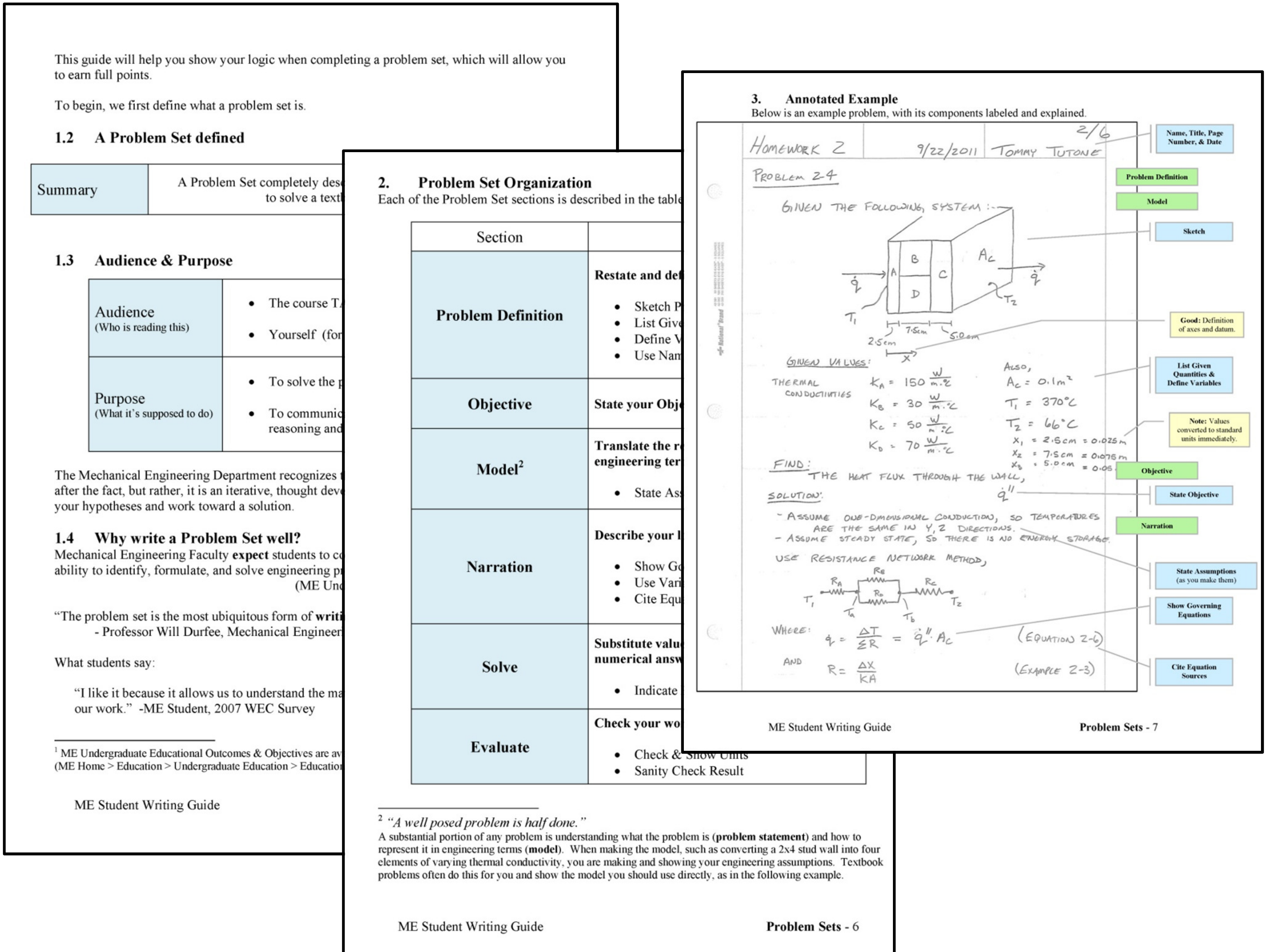
Purpose: to communicate the solution to a problem.

Audience: anyone who has to implement your design, understand your design, or reference it to solve their own unique problem. Typically, this is the project client. While the client may be familiar with the project, the report is still written as thought the client is new to the project.

Source: ME Student Writing Guide
me.umn.edu/education/undergraduate/writing

Guide Evolution





This guide will help you show your logic when completing a problem set, which will allow you to earn full points.

To begin, we first define what a problem set is.

1.2 A Problem Set defined

Summary	A Problem Set completely des… to solve a text…

1.3 Audience & Purpose

Audience (Who is reading this)	• The course T… • Yourself (for…
Purpose (What it's supposed to do)	• To solve the p… • To communic… reasoning and…

The Mechanical Engineering Department recognizes … after the fact, but rather, it is an iterative, thought dev… your hypotheses and work toward a solution.

1.4 Why write a Problem Set well?

Mechanical Engineering Faculty **expect** students to c… ability to identify, formulate, and solve engineering p… (ME Un…

"The problem set is the most ubiquitous form of **writi**…
- Professor Will Durfee, Mechanical Engineer…

What students say:

"I like it because it allows us to understand the ma… our work." -ME Student, 2007 WEC Survey

[1] ME Undergraduate Educational Outcomes & Objectives are av… (ME Home > Education > Undergraduate Education > Education…

ME Student Writing Guide

2. Problem Set Organization

Each of the Problem Set sections is described in the table…

Section	
Problem Definition	**Restate and def…** • Sketch P… • List Give… • Define V… • Use Nam…
Objective	**State your Obj…**
Model[2]	**Translate the r… engineering ter…** • State As…
Narration	**Describe your l…** • Show G… • Use Vari… • Cite Equ…
Solve	**Substitute valu… numerical answ…** • Indicate…
Evaluate	**Check your wo…** • Check & Show Units • Sanity Check Result

[2] *"A well posed problem is half done."*
A substantial portion of any problem is understanding what the problem is (**problem statement**) and how to represent it in engineering terms (**model**). When making the model, such as converting a 2x4 stud wall into four elements of varying thermal conductivity, you are making and showing your engineering assumptions. Textbook problems often do this for you and show the model you should use directly, as in the following example.

ME Student Writing Guide **Problem Sets - 6**

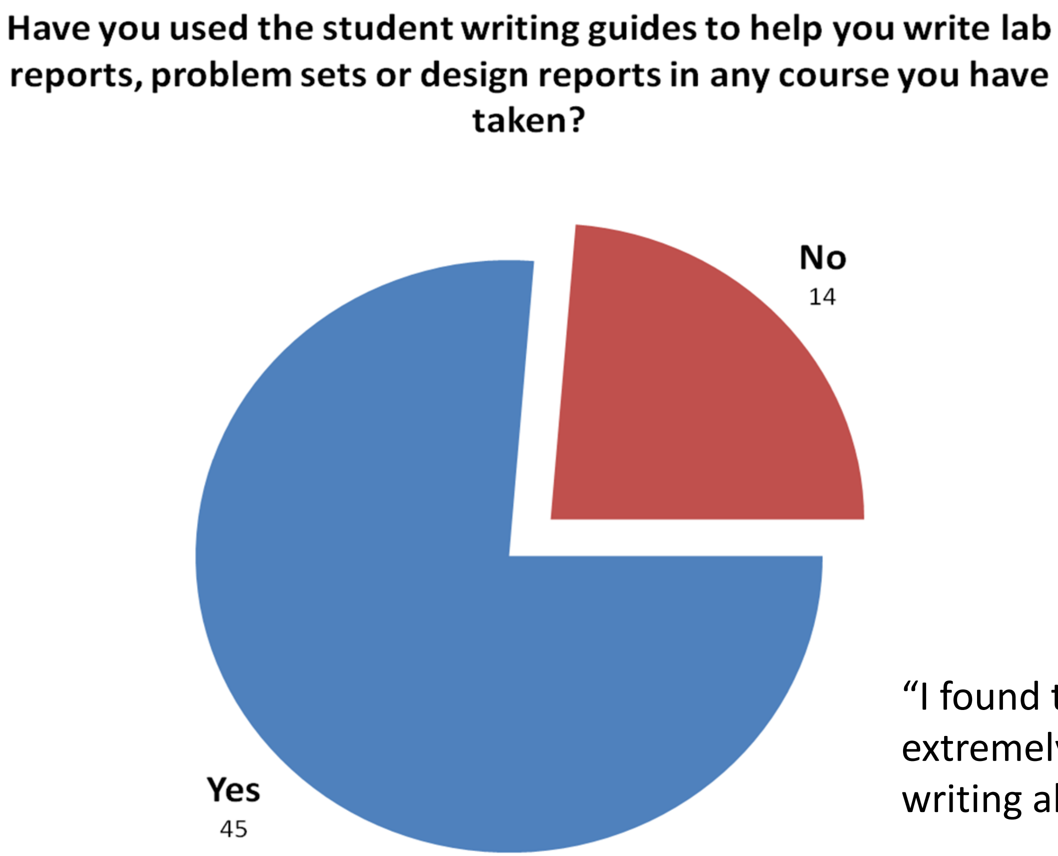
3. Annotated Example

Below is an example problem, with its components labeled and explained.

ME Student Writing Guide **Problem Sets - 7**

Source: ME Student Writing Guide

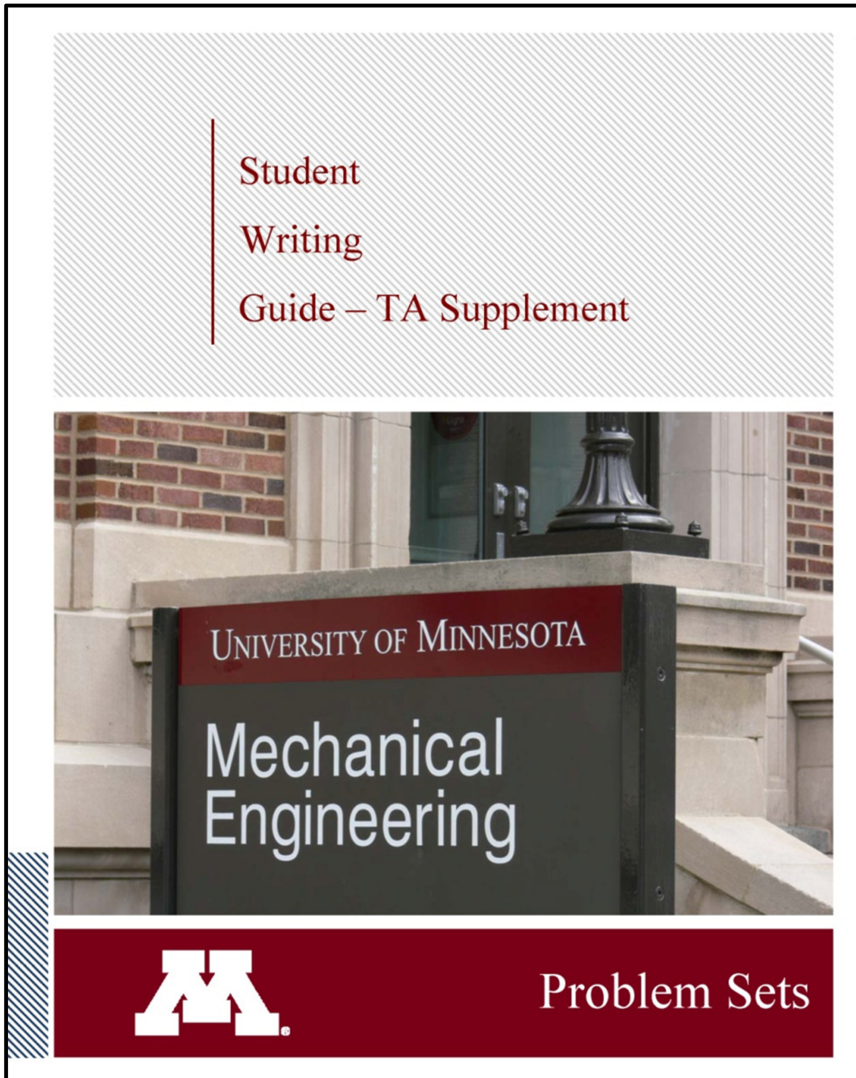
Do they use it? – Survey 2012



"I found the guide for writing formal lab reports extremely helpful and have had it open while writing almost all of my lab reports."

"I glanced at the writing guide…but it seems unnecessarily long … with sections that aren't directly pertinent to the lab report (such as the section called "Why Write Well?")."

Next Step - Bubble Up Instructional Change



5-Minute workshops are a quick and simple way to teach. The organizational theme is roughly three minutes of directed, individual, critical thinking, followed by two minutes of pointed discussion. The activity should result in a teachable moment where the object is clear.

4.1 "Communicating an Estimate"

Organize a small-group activity to be performed quickly in lecture or lab. The goal is to get students thinking about the communicative function of a problem set.

Objective	To teach students the necessary parts of a problem set by asking them to communicate a problem solution.
When to Use	Just before or after the first problem set is due.
Method	Perform an estimation problem in groups. Write the solution to this problem to convince someone else you are correct. Then discuss as a class what you need to communicate this effectively.
Pedagogical Rationale	When the students are asked to communicate a solution themselves, they'll organically discover that all the parts are necessary, and not just an academic exercise.
Example	These are example steps you might take for this activity. **Group Work (3 min)** • Pick a problem, such as "How many ping pong balls would it take to fill this room?" • Divide class into groups of two or three. • Ask each group to write down the solution to this problem in a way that would convince another group it's correct. • Exchange papers between groups. • Ask each team to critique the work. **Class Discussion (2 min)** • Ask the class what parts they needed for to understand what the other students were thinking. • The list will include all parts, except for the problem statement, because it was understood by all there. • Ask for the estimated values and write them on the board. • Based on the values you recorded, emphasize how the validity of the estimate depends on what they wrote (model, calculations, estimated values), not the final numerical value.