

## Helpful Hints to Write Better Problem-Based Learning Design Reports

(or, "There is no reason why you should commit these crimes again.")

(Updated, September 2010)

I will identify areas to improve writing in PBL design reports using the numbering and lettering given below.

### Title

1. Compare your title to the objectives of the report. Can you assess the main point from the title alone?

### Introduction and Conclusion

2. The introduction is more than rewriting the problem statement. Give an overview of the problem and how you solved it. The conclusion should be a good summary of the problem, methods used to solve it, and important results. Make sure that a reader would understand the main topic of your report from reading just the introduction or conclusion. The introduction should be interesting enough to make a reader WANT to continue reading your report.

### Organization-Structural Development of the Idea

3. Hard truth: Even if you get the numbers right, if they are not presented clearly with well developed supporting ideas, you will not get credit (not just in this class) for all your equation crunching labor.
4. Write more specific topic sentences for each paragraph.

Bad example: "After I computed the water requirement, then I designed the channel."

Good example: "A canal bottom width of 12.5 feet was designed to meet the water requirement of 150 cfs."

5. Give results in dimensions that are commonly used (in lecture, textbook, online). For example: ET in 8-10 mm/day or 0.3-0.5 inches/day are numbers someone can understand. Flow in cfs or m<sup>3</sup>/sec (100-300 cfs or 4-5 m<sup>3</sup>/sec) make sense. Flow values of 9,000,000 ft<sup>3</sup>/day is a little harder to visualize. Think about the values you report and make sure that the units make sense for your application.
6. Do not rely on tables, figures, or appendices to explain results for you. Do it yourself, in words. Use tables, figures, and appendices for *additional* illustration. Think: what is the key message I want to the reader to take away from the table/figure/appendix? Then write that message as the text that refers to the table, figure, or appendix. Examples are on the next page.

Poor (student submissions)	Improved (shorter, clear take-away)
Water savings and cost to benefit analysis for water saving practices are outlined in Appendix B.	A low water use laundry machine and insulating pipes had the highest benefit to cost ratio (Appendix B).
The comparison of the water used in this household to the class, city, and state are in Table B1 and Figure B1 (Appendix B).	Monitoring results show the household uses less water than class, city, and state averages (Appendix B).
From the data collected, this household is lower than all other averages.	

7. Do not put an equation in your report unless you want to describe, in words, each of the variables and parameters of the equation. Much of the time the equation is unnecessary and belongs in an Appendix. Exceptions to this might be if you are presenting a new equation, describing the difference between two optional calculations, or believe that discussing the equation is critical to understanding the reasoning behind your assumptions and procedures. If you include an equation, follow this format:
- refer to the equation before presenting it
  - number the equation
  - describe all variables, coefficients, and parameters in the equation including units.

For example:

“The procedure combines intelligence and bravery to calculate coolness (Equation 1):

$$Y = X + a B \tag{1}$$

where  $Y$  is the resulting coolness [kg],  $X$  is intelligence [kg],  $B$  is bravery [feats life<sup>-1</sup>], and  $a$  is a conversion factor [kg feats<sup>-1</sup> life]. The average value of  $a$  was 2.1 feats life<sup>-1</sup>; bravery accounts for more than twice the amount of intelligence normally present in cool people.”

8. Describe figures in the text and refer to them (Figure 1) before they are presented. Label all figures with a description as shown here.



Figure 1: Back of the envelope canal design for transport of 108 cfs.

9. Use a Table to organize related items.
  - a. Each row must represent a single item and each column must have consistent values for each row.
  - b. Use column and row headings to convey these consistent meanings. Avoid tables with lots of blank entries.
  - c. If you find the need to change the meaning of a column or the rows partway through, split the table into two tables so the rows and columns have consistent meanings.
  - d. Order the rows (alphabetically, smallest to largest, largest to smallest, by location, etc.) so the organization is understandable and preferably enhances the table's take away message.
  - e. Describe the take-away message of a table in the text and refer to the table before presenting it.
  - f. Table title should go ABOVE the table, not below as with figures.
  - g. Label each column and include units.
  - h. Labels go in the column header (if consistent for every row) or the row header (if units differ for different rows). Do not make separate columns for units.
  - i. Significant digits are important here also. Engineers rarely know the value of measured data or calculated quantities to a precision of more than three significant digits. Make sure decimal points are aligned in a column (see Flow Requirement).
  - j. Example text and take-away message to reference a table: "Flow requirements exceed 70 cfs for all crops (Table 1)" or "Flow requirements increase with seepage losses (Table 1)."

**Table 1. Additional flow requirements based on seepage losses**

<b>Crop</b>	<b>Seepage Loss (%)</b>	<b>Flow Requirement (cfs)</b>
Primary	58	73.2
Secondary	88	126.
Tertiary	90	159.

- k. Only include an average, total, standard deviation, or other grouping function as the last row of a table if that function is applied to all columns. If not, instead cite the average, total, etc in text. Should you use an average row, make sure the row is labeled and differentiated from the other rows.
- l. Finally, should you need to group and sub groups rows, use either new columns (Table 2) or merge and indent rows (Table 3). If you use the latter, do not put blank rows above or below the group or sub-group headings.

**Table 2. Grouping Crops by Adding New Columns for the Field and Farm**

Farm	Field	Crop	Seepage Loss (%)	Flow Requirement (cfs)
Joe B.	A	Primary	58	73.2
Joe B.	A	Secondary	88	126.
Joe B.	A	Tertiary	90	159.
Joe B.	B	Primary	58	73.2
Joe B.	B	Secondary	88	126.
Joe B.	B	Tertiary	90	159.
Mary S.	A	Primary	58	73.2
Mary S.	A	Secondary	88	126.

**Table 3. Grouping Crops by Merging and Indenting**

Location	Crop	Seepage Loss (%)	Flow Requirement (cfs)
Joe B's Farm			
Field A	Primary	58	73.2
Field A	Secondary	88	126.
Field A	Tertiary	90	159.
Field B	Primary	58	73.2
Field B	Secondary	88	126.
Field B	Tertiary	90	159.
Mary's Farm			
Field A	Primary	58	73.2
Field A	Secondary	88	126.

### Word Usage and Format

10. Hard truth repeated: Even if you get the numbers right, if they are not presented clearly with well developed supporting ideas, you will not get credit (not just in this class) for all your equation crunching labor. Use of “great,” “good,” “bad” from the spreadsheet example, or other generic adjectives should be avoided. Instead, concisely, but exactly, explain ranges, bounds, or other procedures and assumptions.
11. Some of you would greatly benefit from the help of the USU Writing Center. Make use of your university resources (<http://writingcenter.usu.edu/>). I have gone there, they are really nice and will help you write much better papers. Plan ahead so you have time to get their help before the due date. If you do not take your paper to the writing center, **have the best writer you know edit it before turning it in.**
12. Numbers (integers) with less than 10 should be written out.

Correct: ...three years of data was used...

Incorrect: ...3 years of data was used...

Also correct: ...20 years of data was used...8.4 miles of canal

Correct: Alternative 1 was chosen; An interest rate of 5% was used.

Incorrect: Alternative one was chose; An interest rate of five percent was used.

13. The word processor is your friend; details count. Correct: ft<sup>3</sup>/sec. Unacceptable: ft<sup>^3</sup>/sec.

14. Significant digits, think about them:

Correct: 7.52 mm/day

Incorrect: 7.5234872930 mm/day

Correct: \$30,000,000 or \$30 million dollars

Incorrect: \$30,000,000.72

15. PBL reports should avoid long, detailed narration in first person.

Incorrect: "First I used a crop coefficient of 1.2. Then I calculated evapotranspiration. Finally, I added pan evaporation."

Better: "I used a crop coefficient of 1.2 to calculate evapotranspiration then added pan evaporation.

Even better: Evapotranspiration was calculated using a crop coefficient of 1.2 [unitless] and pan evaporation.

16. Proper names should be capitalized, e.g., Base Case, No Frills Alternative, Bells and Whistles Design.

17. Use Spell Check!!!!

18. A Table of Contents is not necessary for a two-page report.

19. Write out names at their first occurrence in the text before using abbreviations for them in the text, e.g., operation and maintenance (O&M), crop coefficient ( $K_c$ ).

## Engineering Design

20. Make sure you balance your presentation of procedures, results, and discussion with the requirements of the problem statement. Make sure that everything you present (procedure, results, discussion) works directly towards specifically addressing the issues of the design problem. Make sure all answers are well supported with explanation and analysis. You will be marked off if you fail to address issues stated in the problem.

## Conclusion

21. Include the main results AND summarize the important points determining how you arrived at your conclusions. Also include numerical results to support important conclusions. At this point, read back through the problem and make sure you are answering the questions that have been posed.

## References

22. All references must be cited in the text. See the ASCE publications website for descriptions and examples (<http://pubs.asce.org/authors/book/generalresources/references.htm>). You must also cite your own work (Bandaragoda, 2005) and list it in the reference section with proper formatting.
23. You are required to have a **References** section. According to the ASCE, "All references should appear together *single-spaced and left-justified* at the end of the paper but before the Appendices. References are listed alphabetically by last name of the first author. When two or more references by the same author are listed, year of publication is taken into account, and the earliest work is listed first. If these occur in the same year, the year is followed by alphabetical numeration (e.g., 2000a, 2000b, 2000c).

Wherever reference is made in the text to an author's work, the author's name and year of publication should appear in parentheses. All listed references must be cited in the text. For material that is not cited in text, create a section or an appendix called 'Additional Information or Related Material'." In the reference page, the date always immediately follows the author's name(s). Reference formats are illustrated below that you could have googled yourself; there will be no excuses for bad citations in the PBL design reports. Some additional formats are listed below or look up articles in any ASCE publication.

### Interview or personal communication

Gates, W. (2001, March 15). CEO, Microsoft Corporation. Personal interview.

(Note that the citation should indicate the person's position; telephone interviews are also acceptable.)

### Long URLs

URLs that will not fit on one line of your Works Cited list should be broken at slashes, when possible. Some Web sites have unusually long URLs that would be virtually impossible to retype; others use frames, so the URL appears the same for each page. To address this problem, either refer to a site's search URL, or provide the path to the resource from an entry page with an easier URL. Begin the path with the word Path followed by a colon, followed by the name of each link, separated by a semicolon.

Example: The Amazon.com URL for customer privacy and security information is <<http://www.amazon.com/exec/obidos/tg/browse/-/551434/104-0801289-6225502>>, so we'd need to simplify the citation:

Amazon.com. "Privacy and Security." 22 May 2006 <<http://www.amazon.com/>>. Path: Help; Privacy & Security.

### **Print source found online**

VandenBos, G., Knapp, S., & Doe, J. (2001). Role of reference elements in the selection of resources by psychology undergraduates [Electronic version]. *Journal of Bibliographic Research*, 5, 117-123.

### **Government agencies and acronym examples**

In the text, reference to information derived from a website uses the acronym (USGS, 2000a) and should be followed by a formatted citation as in this example:

USGS (U.S. Geological Survey). 2000a. Real-Time Water Data. <http://water.usgs.gov/realtime.html>.

If it is a report (UNEP, 1993) use a report format such as:

UNEP (United Nations Environment Program). 1993. Environmental Data Report 1993-94. Cambridge, MA: Blackwell.

Use a reference software program like EndNote to manage your references and format citations.

## **Appendix**

24. For full points, you must include:

- a. A separate appendix for each topic
- b. Each must have a title. Appendix A: Use of the Manning's equation
- c. Each must include discussion and explanation; the reader should understand what the additional information is about independent of the text.
- d. Proper formatting and display of information is required. DO NOT copy and paste enormous Excel spreadsheets into an appendix. If you have collected data from other sources, it is sufficient to refer to these sources without presenting someone else's data in your Appendices. Unless you have created or collected the data yourself, it is not recommended that large data tables be included.
- e. Refer to the Appendices in the text, but do not rely on them. The text should have sufficient detail to stand on its own. Appendices provide supplemental information.

- f. Numerically order the appendices in the order in which they are referenced in the text.

25. A note on Appendices (plural for Appendix):

The appendix will only be read if the reader has further questions about how things were done beyond the scope of the results in the report. Balance what you present in the text of the report and what you put in the appendix. To decide whether to put something in the report or in an appendix, read the report from beginning to end, and if any material slows down the pace of the reading, either rewrite it (if it was badly written), or put it in the appendix (if it presented too much information). The results, assumptions, and discussion should all be in the body of the paper. Do not refer the reader to the appendix to discover the results of your work. Appendices are for information that is not directly within the scope of the paper or too detailed to explain in entirety.

Example: Describing the use of the Reservoir Mass Balance equation and necessary assumptions is within the scope of one of your PBL reports since it directly effects the reservoir release decision and calculation of firm yield. Details on, for example, the method used to calculate evaporation or seepage, do not inform the reader of an important result or an assumption that directly affects the value of the result. In general, use appendices for tangential information that does not directly concern the objectives of the report. A reader can refer to them if they want to explore the specifics of your work, but does not need to look at them to sleuth out the main results. You are not required to include an Appendix, but if you do, it must be done properly. For example, if an appendix contains a table, you must have a title, introduce and explain why it is being included, and discuss the result presented in the table as well as any other comments necessary for the reader to understand what the appendix is about. There must be separate appendices for each supplementary information topic you are presenting.