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Teaching Laboratory Data Management (TLDM) System

What is the motivation?

Data calculations are an essential part of the teaching laboratory, but the large amounts of data generated daily in the classroom can be difficult to deal with for both students and teachers. The goal of the TLDM system is to serve as a unified platform for students, teaching assistants and instructors to work with experimental data.

How does the TLDM System help?

Students:

- Provides an example of complete raw data and expected values
- Ensures group members and teachers use the same raw data
- Guides students through calculations and gives instant feedback
- Demonstrates an example of a good spreadsheet
- Outlines what values and figures to include in reports

Teaching Assistants:

- Generates answer keys specific to student's/group's raw data
- Reduces grading time and errors during marking

Instructors:

- Archives raw data for course development
- Tracks student and lab equipment performance

What is the TLDM System?

The system involves 5 Microsoft Excel files:

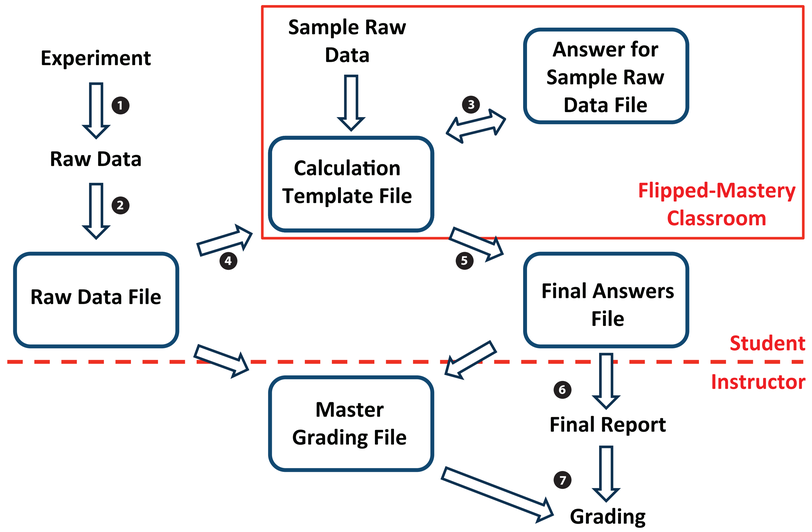
Calculations Template File
Preformatted tables containing sample raw data and instructions that guide students to enter formulae to calculate final results and generate diagrams

Answers for Sample Raw Data File
Tables containing results derived from the sample raw data

Raw Data ("D") File
Preformatted tables for students to record their own raw data

Final Answers ("A") File
Preformatted tables for students to enter their calculated results

Master Grading ("C") File
Calculations template file that contains all formulae required to generate correct final results for any set of input raw data



How it works?

1. Students perform laboratory experiment and generate raw data.

2. Students enter their raw data into the "D" file and submit it.

3. Students enter formulae into the "calculations template" file to generate results based on the provided sample raw data. They check these calculated results against those found in the "answers for sample raw data" file as a means of receiving instant feedback to validate the correctness of their calculations. These two files form a Flipped-Mastery classroom within which students can fully develop their calculations until they are all correct.

4. Students enter their own raw data into the completed "calculations template" file to obtain the correct final results for their experiment.

5. Students enter their final results into the "A" file.

6. Students include the final results in their lab report and submit the completed "A" file for grading.

7. Instructors use the "C" file to generate answer keys based on the raw data in the "D" files to grade values in the corresponding "A" files.

Where is it being used at UBC?

TLDM modules have been created and successfully implemented in CHBE 262, CHBE 362, CHBE 366 and CHBE 364 Chemical Engineering Laboratory courses (n = 400).

What is the impact on education quality?

- Enforces traceability and accuracy of raw data
- Increases grading transparency and feedback
- Promotes complete understanding of all course material
- Facilitates discussion of calculated results that is not limited by the accuracy of calculations
- Provides a unified platform for academic discussion between students and teachers, and among students
- Covers the use of advanced features in Microsoft Excel

How it scaffolds student learning?

As students advance to more senior years, components of the TLDM system can be added or removed to tailor to their evolving needs as shown in the table below:

Undergraduate Year	2	3	4
Sample Raw Data	✓	✓	✓
Answers for Sample Raw Data	✓	✓	✓
Labeled and Formatted Data Tables	✓	✓	
Step-by-Step Annotated Instructions	✓		
Partially-Prepared Figures	✓		
Discussion of Sample Results			✓

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