Consultation, Communication, and Collaboration: A project course to engage statistics students in the three C's

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Why?

The setting:

- The University of Toronto is a large research university.
- There are many undergrads involved in research in other units.
- There are some very talented graduate students.
- Traditionally, the strength of the statistics department has been in theoretical statistics.

The motivation:

- Engage our students in statistical thinking.
- Satisfy the core competencies that all graduates of the University of Toronto Faculty of Arts and Science are expected to acquire.
- Enhance collaborative activity with other departments.

What?

STA 490:
Statistical Consultation, Communication, and Collaboration

A capstone course for undergraduate students in statistics programs, centred around a collaborative project with a research student from another discipline.

Some features of the course:

- The collaborative relationships are peer-to-peer.
- Senior PhD students in statistics are the project supervisors and receive mentoring.
- There is a large number of stakeholders.
- I don't teach any methodology.
- But students learn methodology.

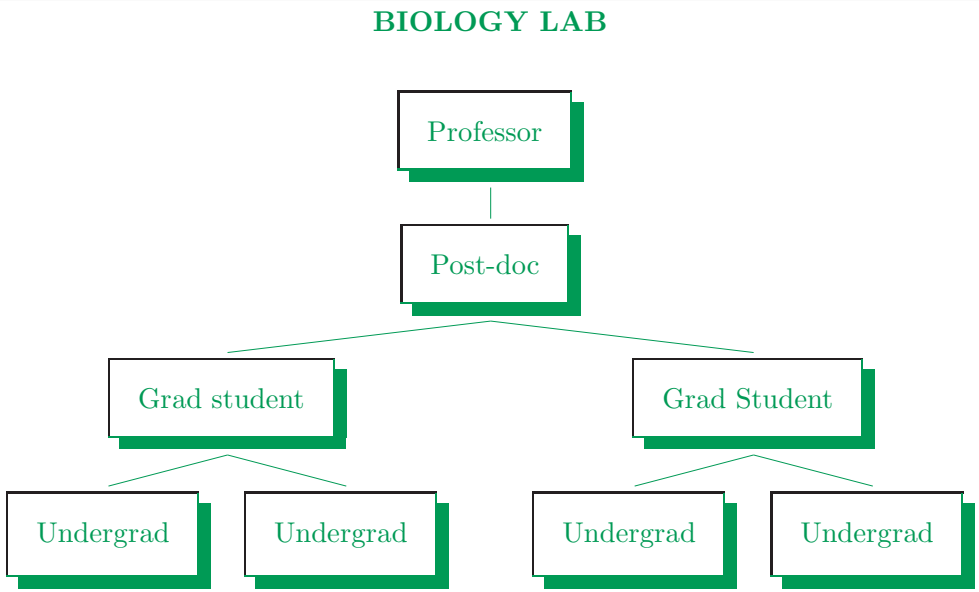
Course Mantra

It's OK not to know.

Expressing ignorance is encouraged.

It's not OK to not have a willingness to learn.

How? The Course Structure Part 1: A model from laboratory sciences



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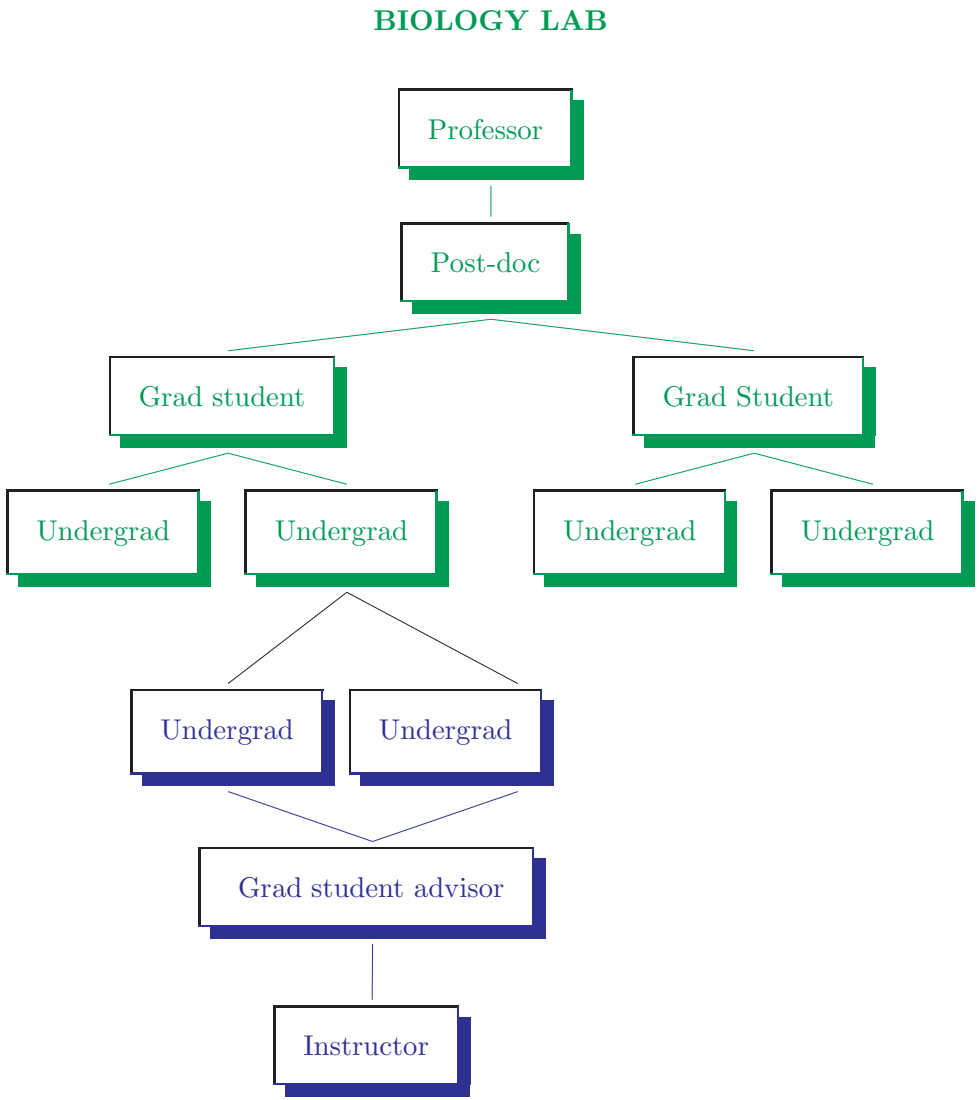
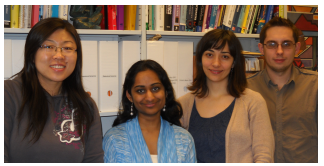


The Course Structure Part 2: Class and project team meetings

- The course is a half credit course.
- We started by offering it in January through April.
  - Weekly 2-hour seminar in statistical collaboration.
  - Weekly research group meeting.
    - 2 or 3 STA 490 students
    - Statistics graduate student advisor
    - Collaborator from another discipline:
      - 4th year student working on a research project
      - attended 4 meetings at planned points throughout the term
- This year it is running from September through April.
  - Changed in response to feedback from collaborators, their advisors, and the STA 490 students.
  - Either a seminar or a project team meeting each week.
  - Ratio of number of seminars to number of project team meetings decreases as the year progresses.
  - Collaborators attend 5 meetings throughout the year.

Who? The Stakeholders

1. The STA 490 students
   - fourth year statistics students 
2. The collaborators from other disciplines
   - early career (4th year and master's) research students from Psychology and Biology (so far ...)
3. The collaborators' supervisors
   - professors and their post-doctoral fellows and senior graduate students
4. The statistics graduate student advisors
   - senior PhD students in Statistics 
5. The STA 490 instructor (*facilitator? exemplar? mentor?*)

Making it work 1: Setting it up

Main piece of advice: You can't be organized enough!
Have planned before starting:

- when the collaborator meetings will be
- common times and rooms for project team meetings
- what you expect will be accomplished at each project team meeting
- regular student reports on their projects
  - class presentations or
  - one-page summaries of meetings and next steps

Making it work 2: Taking advantage of university resources

What I learned from two key people:

1. Writing Instruction Resource
   - We're the best equipped to evaluate writing results of statistical analyses.
   - Focus on the big ideas and not the grammar.
   - Incorporate revision in the process.
   - Make the draft count.
   - Students develop critical appraisal of their own writing by seeing examples of other students' writing (with permission).
   - Assignments with clear expectations and a clear purpose are easier to grade.
   - Give separate grades for the writing and the statistical work.

Making it work 2:
Taking advantage of university resources

2. Teaching Assistant Training Program
   - For every meeting, think carefully about the meeting process.
   - Spread the TA training throughout the course.
   - Have a benchmarking session for written assignments.
     - Pick a few student assignments of various caliber.
     - TAs and instructors meet to discuss:
       - What is good about the assignment?
       - What is bad about the assignment?
       - What comments would you make?
       - What grade would you give?
   - Read *A TA's Guide to Teaching Writing in All Disciplines* by Hedengren, especially chapter 10.

Making it work 3: Good projects

Characteristics of a good project:

- The faculty advisor is willing.
- The statistical analysis isn't trivial.
- The data will be ready in time.

Making it work 4: Good TAs

- Carefully chosen:
  - students from my graduate consulting course
  - interested in consulting and collaborative research
  - interested in communication
  - interested in improving supervisory skills
- Given opportunities for their development as supervisors:
  - group meetings
  - formal and informal meetings with faculty instructor
  - lots of e-mail discussion
  - given feedback after each time faculty instructor sits in on project meetings

An approach to supervision:
(Murray (1998) as quoted by Marshall on page 150 of *A Handbook for Teaching and Learning in Higher Education*)

> *A good waiter in a good restaurant is around enough to help you when you need things but leaves you alone enough to enjoy yourself.*

Need funding!

Making it work 5: Topics for class seminars

Some of the topics covered:

- **Statistical practice**
  - Some example topics:
    - Skills required of practicing statisticians
    - Replication versus pseudo-replication
    - Short case studies that may require non-standard analyses
  - Examples of readings:
    - Chris Chatfield (2002) Confessions of a pragmatic statistician. *The Statistician* **51**, 1-20.
    - The series of statistics notes in *BMJ* primarily by Bland & Altman.
    - Joseph P. Simmons, Leif D. Nelson, and Uri Simonsohn (2011) False-Positive Psychology: Undisclosed Flexibility in Data Collection and Analysis Allows Presenting Anything as Significant. *Psychological Science* **22**, 1359-1366.
- **Graphs and tables**

Making it work 5: More topics for class seminars

- **Writing reports of statistical analyses**
  - Topics:
    - Structure of a report
    - Characteristics of a good report
    - Common mistakes extracted from past student reports

      An example: "Subjects did not perceive themselves as statistically significant."
- **Ethics**
  - Short case studies

    An example: Healthy human subjects are recruited to test the safety of new drugs. They are paid for their participation. Is there a role for statisticians in determining the appropriateness of this?
  - Readings: American Statistical Association and Statistical Society of Canada guidelines for ethical practice

Making it work 6: Evaluation
The current course evaluation scheme

	Weight	
Attendance:	5%	class meetings
	5%	project team meetings
Participation:	5%	class meetings
	5%	project team meetings
Preparation for project team meetings	5%	
Project presentation to class 1	5%	
Project presentation to class 2	5%	
Project presentation to class 3	5%	
One page project summary	5%	
Writing assignment	10%	
Draft of final report for collaborator	5%	
Draft technical summary	5%	
Results presentation to collaborator	5%	
Final report for collaborator:		
Statistical work	15%	
Writing	10%	
Final technical summary	5%	

Making it work 6: Evaluation
An example of expectations

Requirements for summary of first meeting with collaborators
The purpose of the first meeting with your collaborator is for you to learn as much as you can from your collaborator about your project.
Your summary should be at most one page and should include:

1. Basic information:
    a. Date of meeting
    b. Collaborators name and department
    c. Names of everyone present at the meeting
2. A summary of the project, in words both you and your collaborator would understand. Include the research questions the collaborator is attempting to answer and the goals of the project for this term (which may vary depending on the current stage of the research).
3. A summary of the data. What has been or is being or will be collected? When will the data be available? If there will be no data for the project, what information do you have in order to answer the collaborators questions.
4. A summary of potential statistical issues, in words you and your TA would understand.

For all of the above, identify anything that you are unsure about. Do you need more clarity from your collaborator? Or from your TA?

Making it work 6: Evaluation
An example rubric

- The writing instructor recommended and the TAs requested holistic rubrics.

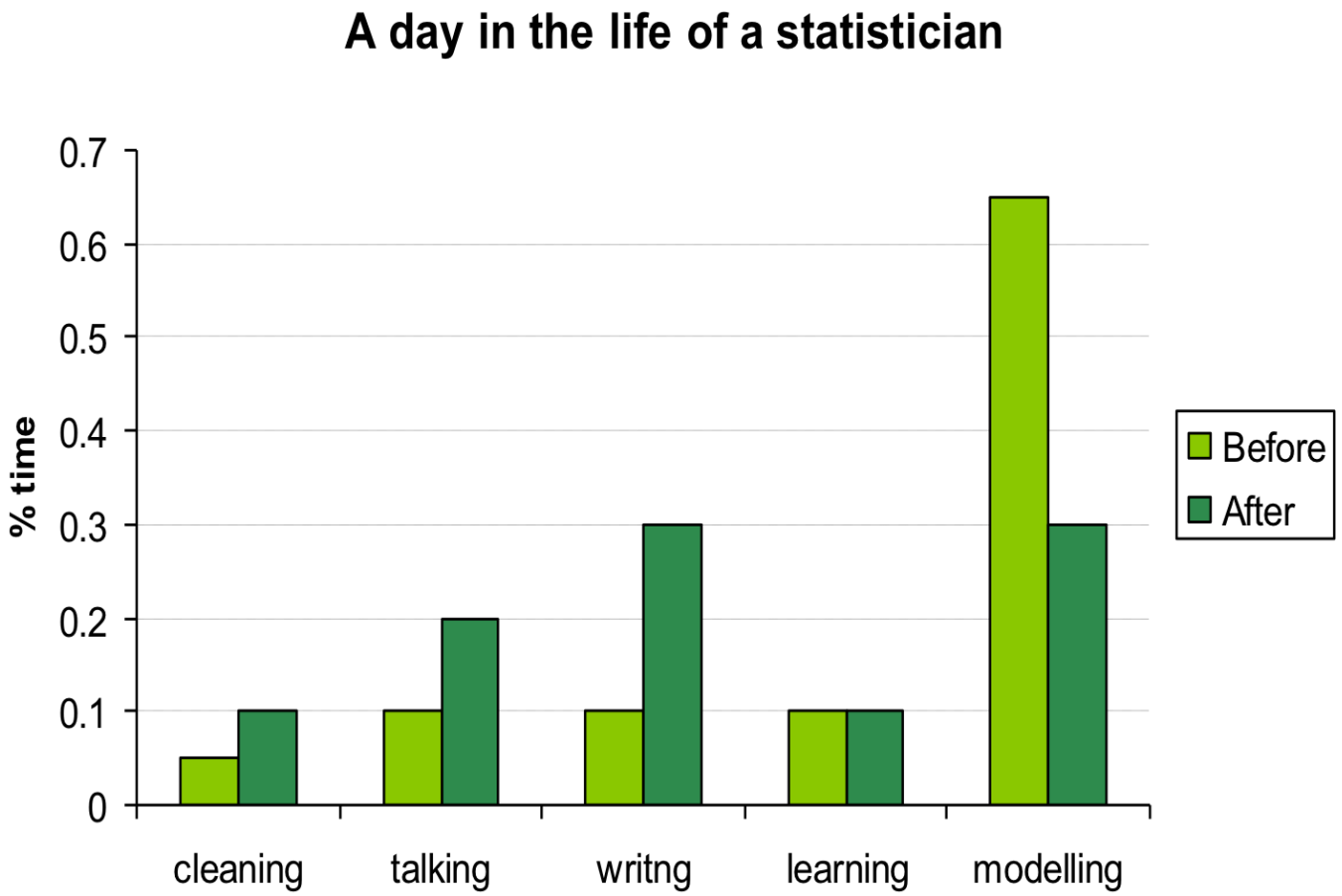
Evaluation of summary of first meeting with collaborators

Your grade will reflect how well you:
1. Understood the project and its purpose.
2. Identified relevant statistical issues, recognizing possible problems.
3. Communicated clearly, succinctly, and effectively in writing.

- TAs give written comments on each of these components and one overall mark.

The final word from a STA 490 student

From Jana's final presentation, on the influence of the course on her perceptions of statistical practice:



References

On statistical thinking:

- Brown, E.N. and Kass, R.E. (2009), "What is Statistics?" (with discussion), *The American Statistician*, 63, 105-123.
- Meng, X.-L. (2009), "Desired and Feared – What Do We Do Now and Over the Next 50 Years?", *The American Statistician*, 63, 202-210.
- Gibbs, A.L. and Guimond, T. (2010), "Lessons from Medicine for the Training of Statistical Consultants", *Proceedings of the 8th International Conference on Teaching Statistics*, Ljubljana, Slovenia.
  I've taught a graduate course in statistical consulting for almost 10 years. This paper includes some of my thinking about training students in statistical practice related to that course.

On supervision and TA training:

- Fry, H. et al, ed. *A Handbook for Teaching and Learning in Higher Education: Enhancing Academic Practice*, Routledge, 2009.
- Hedengren, B.F. *A TA's Guide to Teaching Writing in All Disciplines*, Bedford/St. Martin's, 2004.

Some other great capstone courses:

- St. Olaf College:
  Legler, J. et al. (2010), "A Model for an Interdisciplinary Undergraduate Research Program," *The American Statistician*, 64, 59-69.
- University of Georgia:
  Lazar, N.A. et al. (2011), "A Capstone Course for Undergraduate Statistics majors," *The American Statistician*, 65, 183-189.