

Teaching the Fundamentals of Statistical Practice: *The three C's*

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The three C's

1. Consultation
2. Communication
3. **Collaboration**

Another C: [Capstone course](#)

STA 490:

Statistical Consultation, Communication, and Collaboration

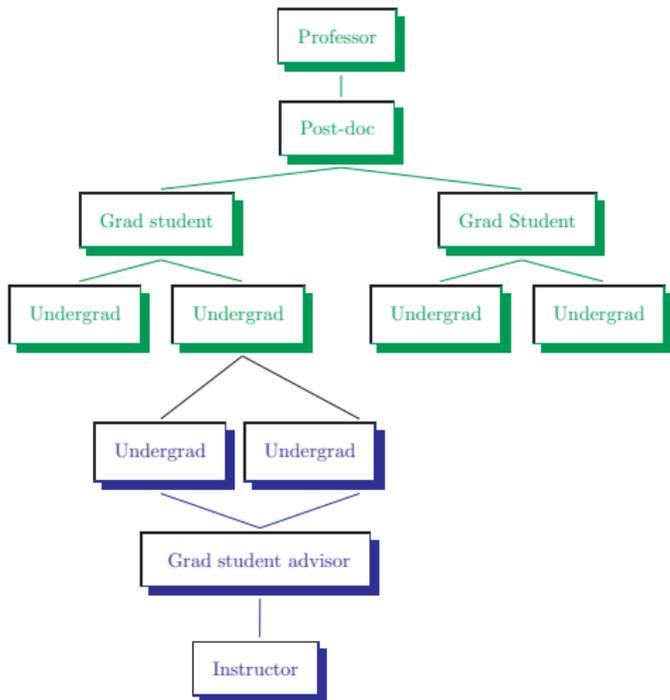
A capstone course for undergraduate students in statistics programs, centred around a collaborative project with a research student from another discipline.

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 Course Structure Part 1: A model from laboratory sciences

BIOLOGY LAB



The Course Structure Part 2

Course took place in the winter term and met twice weekly.

① *Tuesdays*: Seminar in statistical collaboration.

Examples of topics covered:

- Verbal and written communication
- Presentation of data in tables and graphs
- Ethical practice
- Things to watch out for
- Is most scientific research wrong?
- Guest speaker, consultant to pharmaceutical industry

② *Thursdays*: Research group meetings.

Members of the research team:

- 2 or 3 STA 490 students
- Statistics graduate student advisor
- Collaborator from another discipline
 - 4th year or master's student working on a research project
 - Attended 4 meetings at planned points throughout the term

Course mantra: *It's OK not to know.*

What makes the course unique?

The number of 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 in EEB and their post-doctoral fellows and senior graduate students

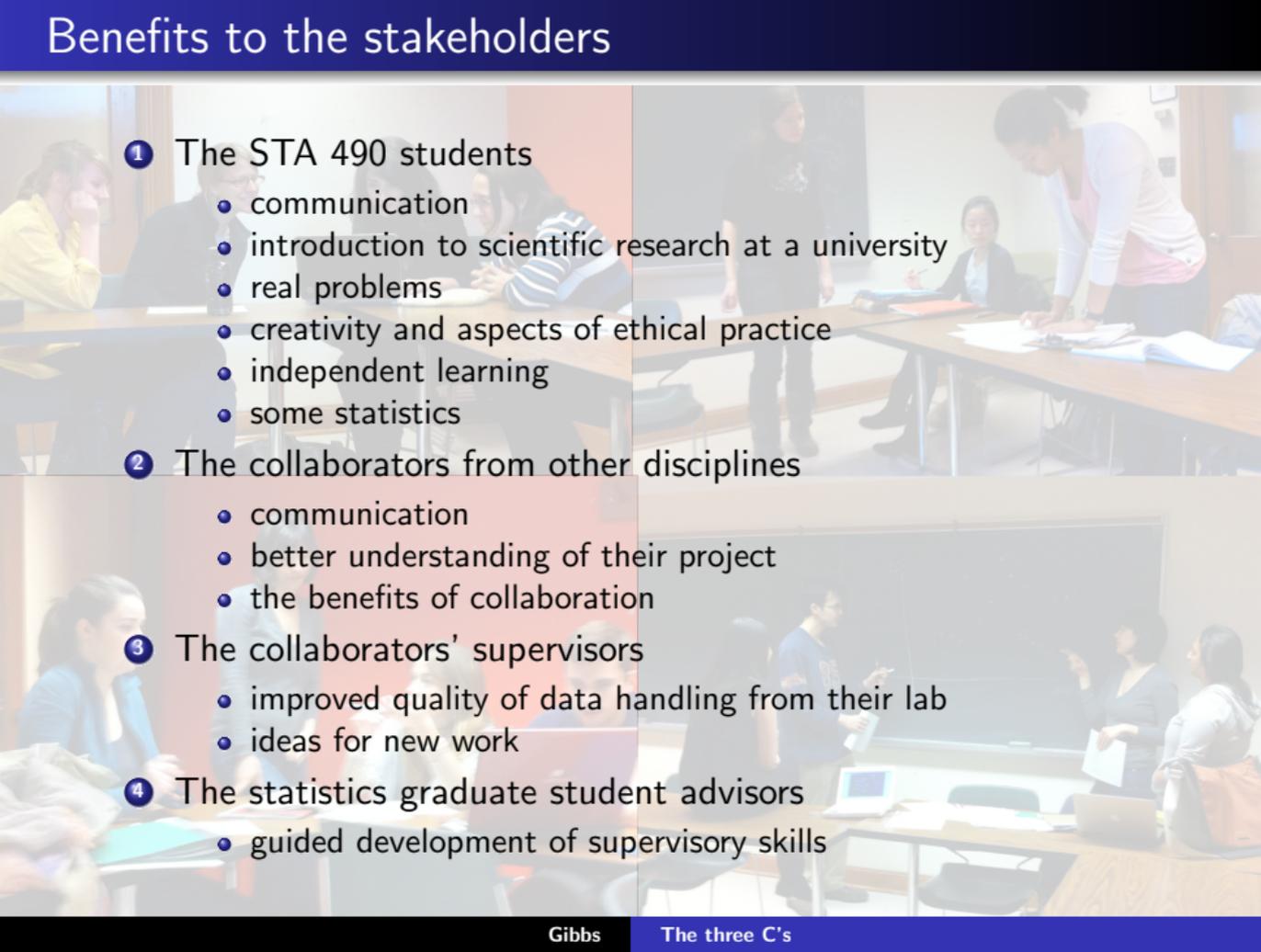
④ The statistics graduate student advisors

- senior PhD students in Statistics



⑤ The STA 490 instructor (*facilitator?*)

Benefits to the stakeholders

- 
- 1 The STA 490 students
 - communication
 - introduction to scientific research at a university
 - real problems
 - creativity and aspects of ethical practice
 - independent learning
 - some statistics
 - 2 The collaborators from other disciplines
 - communication
 - better understanding of their project
 - the benefits of collaboration
 - 3 The collaborators' supervisors
 - improved quality of data handling from their lab
 - ideas for new work
 - 4 The statistics graduate student advisors
 - guided development of supervisory skills

Student attitudes about useful skills for statistical practice

Before:

context creativity **curiosity** empathy ethics
infoliteracy learn methods software
teach teamwork timemanagement verbal
writing

After:

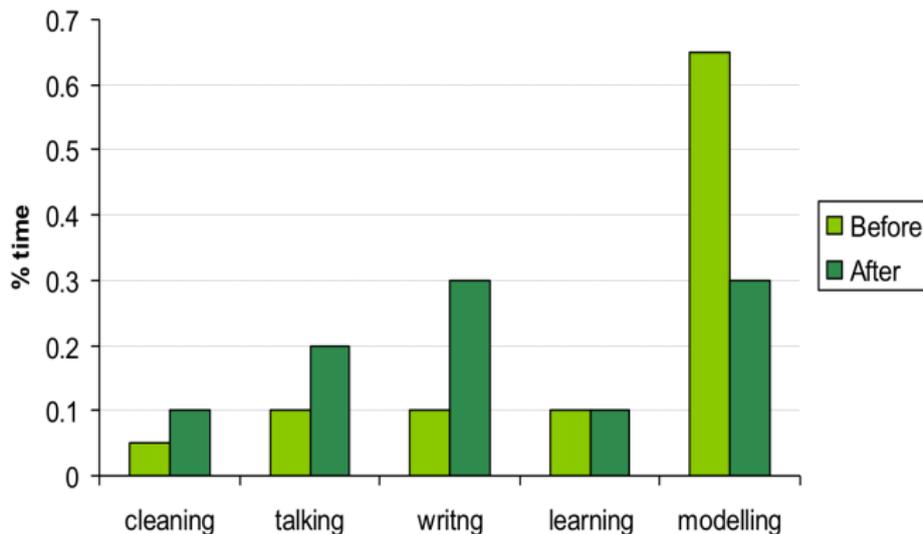
context creativity **curiosity** empathy ethics
infoliteracy learn methods software teach
teamwork timemanagement **verbal**
writing

After the course: Students ranked knowledge of methods and software as less important (“not everything”) and verbal communication and other softer skills as more important (“increasingly clear how important communication was”).

Attitudes about statistical practice part 2

From STA 490 student Jana Stoilova's final presentation, on the influence of the course on her perceptions of statistical practice:

A day in the life of a statistician



What's the result?

Influence beyond the course participants:

- The statistics department is becoming very popular. Participating departments are asking to send next year's research students to be collaborators.
- Wider influence on research. The faculty supervisor of a collaborator: "We're treating our data differently now."
- The course helped inspire a new undergraduate program in applied statistics, focussed on the collaborative nature of the discipline.

One final additional C: **Challenges:**

- The new undergraduate program requires a concentration in a discipline that uses statistics. Can we manage to have each student have a project in his/her area of concentration?
- Transition to a full-year course.
- Sustainability of T.A. funding.
- How to get everyone in the department involved.

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.

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.

The final word from a STA 490 student:

This class is the kind that makes tuition worth paying instead of paying for faster internet.