Recent Developments in the Transformation of Statistics Courses

With Highlights on Revisions to STAT 241/251 Labs

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Abstract

We display here a brief summary of the courses being transformed as part of the involvement of the Department of Statistics with the CWSEI and the improved methods used during the past year. Highlighted are the results of approaches used to dispel students' misconceptions and the details of revisions made to computer-based labs. The improvements in student performance and feedback suggest the methods implemented can yield tangible benefits.

Courses Being Transformed

	STAT 200	STAT 241/251	STAT 302
Title	Elementary Stats for Applications	Intro Probability & Statistics	Intro to Probability
Description & Audience	Intro course for Science students	Intro course for Comp Sci. & Applied Sci. students	Core course for Stat majors and other Science students
Enrolment	~ 900 per year Multi sections of 150-200	~ 700 per year Single section of 250-300	~ 130 per year Two sections of 60-70
Offered	Each term	Each term	Term 2

Methods Used

Learning Outcomes	Interventions for Misconceptions	Formative Assessments
Student & TA Feedback	Student Engagement	Cooperative Learning

Learning Outcomes

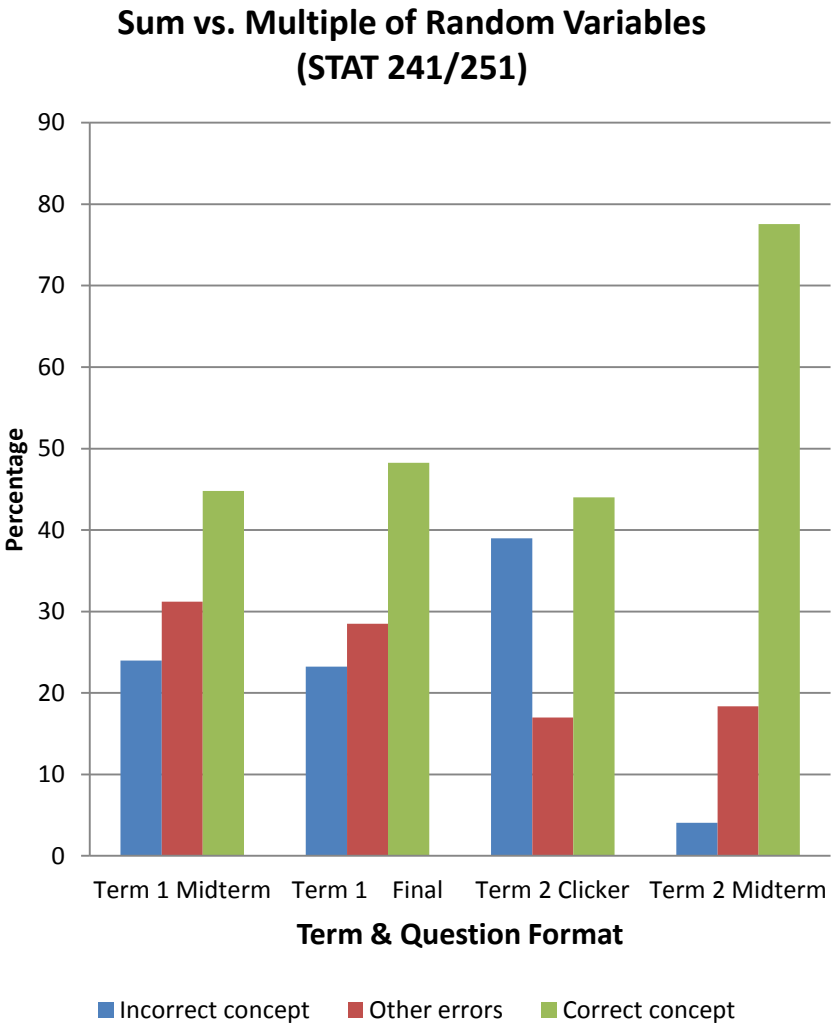
- Main aims of the course
- Individual *Learning Outcomes* under each aim
- Aligning course material with the defined Learning Outcomes
  - Lectures
  - Labs
  - Assignments & Exams

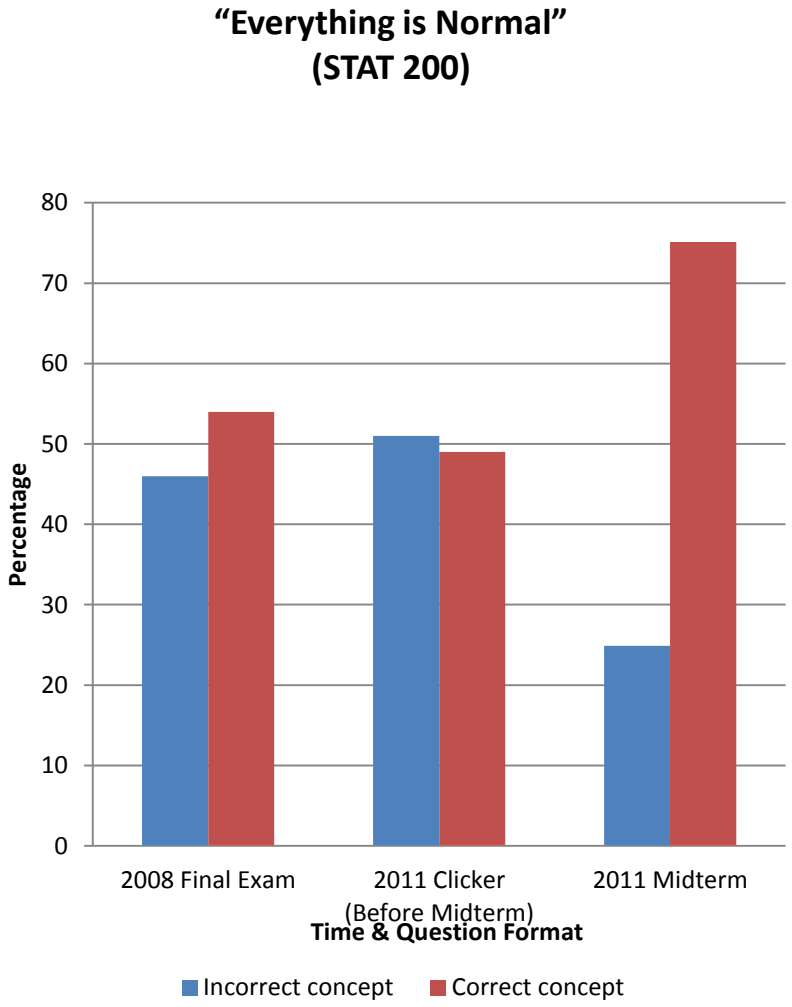
Interventions for Misconceptions

- Clicker questions during lectures
  - To alert students to the misconceptions
  - To elicit a discussion

- Assessment questions in exams
  - To target misconceptions
  - To compare pre-post intervention results

Interventions for Misconceptions: Examples





Formative Assessments

- Bi-weekly written assignments
  - Simpler marking schemes to handle the large number of assignments per course
- Clicker questions
  - Pop quizzes in course currently without clickers

Student Engagement

- Student collected data and/or examples that pertain to student lives
  - In lectures and assignments
- Clicker questions
  - During lectures
- In-class activities
  - In small informal groups, during lectures

Student Engagement: Example
Student Collected Data (STAT 200 Assignments)

Books in the fifth floor of the UBC Koerner Library

Part I:

- Devise sampling plan
- Collect data
  - Whether book was published before 1980
  - Age of book
  - Number of pages
- Summarize data
  - Summary stats
  - Graphical displays

Part II:

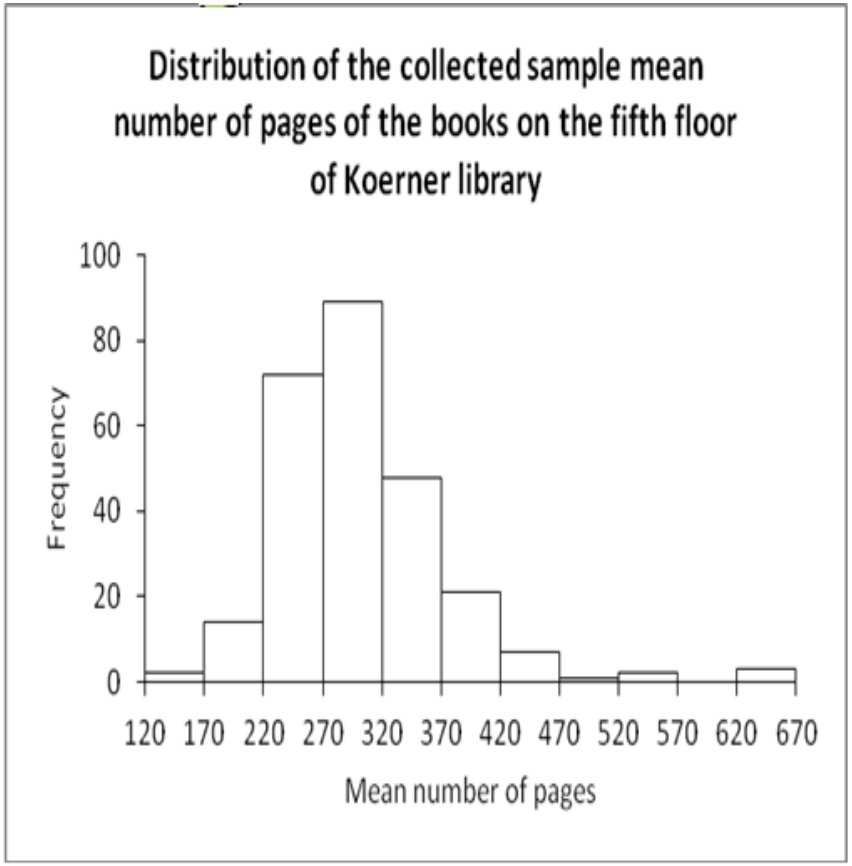
Individual data combined

- Summarize data
- Make inferences
  - True *population proportion* of books published before 1980
  - True *population mean* age of books and number of pages
  - Confidence intervals

Student Engagement: Example
Student Collected Data (STAT 200 Assignments)

Books in the fifth floor of the UBC Koerner Library

Student	Sample Mean Number of Pages of Books
1	648.7
2	288.45
3	283
4	243.95
5	275.4
6	377
:	:
:	:



Student & TA Feedback

- Mid-course student surveys
  - Provide feedback on lectures & labs

- Weekly Lab TA surveys
  - TAs provide feedback on student and TA difficulties in STAT 241/251 & STAT 200 Labs

    - Identify areas that need improvement
    - Implement possible improvements this term, and make plans for subsequent terms

Cooperative Learning

- In-class group activities
  - Informal, self-selected groups
  - Work is not graded
- Group work in Labs
  - Formal, pre-selected groups
  - Work is graded

Revisions to STAT 241/251 Labs

- **Description**
  - Eight labs, 50 minutes each
  - To give students opportunities to analyze data, as well as to do simulations to better understand statistical concepts
  - Using R
    - a free software for statistical computing and graphics, which is often used for research in statistical methodology
  - Students work in groups
    - About 60 students per lab, with two TAs

Labs: Motivation for Revisions

Student Dissatisfaction (Mid-Course Survey)	Observations by Lab TAs (End of Term Survey)
Lack of structure Difficulties with programming, which overshadowed the objectives of the labs Difficulties with working in large groups	Students were not prepared (although pre-reading materials were made available) Lack of engagement & cooperative learning Students were not punctual

Labs: Stage 1 Revisions

Lab Groups

Lab Structure

Pre-Reading Material

Lab Exercises

Labs: Revisions to Groups

	Before	After
Group Selection	Self selected	Pre selected Based on - Major - Gender - Year in school
Size	5-6	3-4

Main Reference: *Teaching Problem Solving Through Cooperative Grouping,* Heller, P., Hollabaugh, M. , Am. J. Phys. 60(7), July 1992

Labs: Revisions to Structure

Before	After
Group work on lab exercise (Exercise available in advance)	Pre-reading quiz - Four multiple choice questions - Two versions - Easy to answer (if student has simply read the pre-reading document) - Given during the first 5 minutes of the lab Brief intro by TAs Group work on lab exercise (Exercise not available in advance) Wrap up

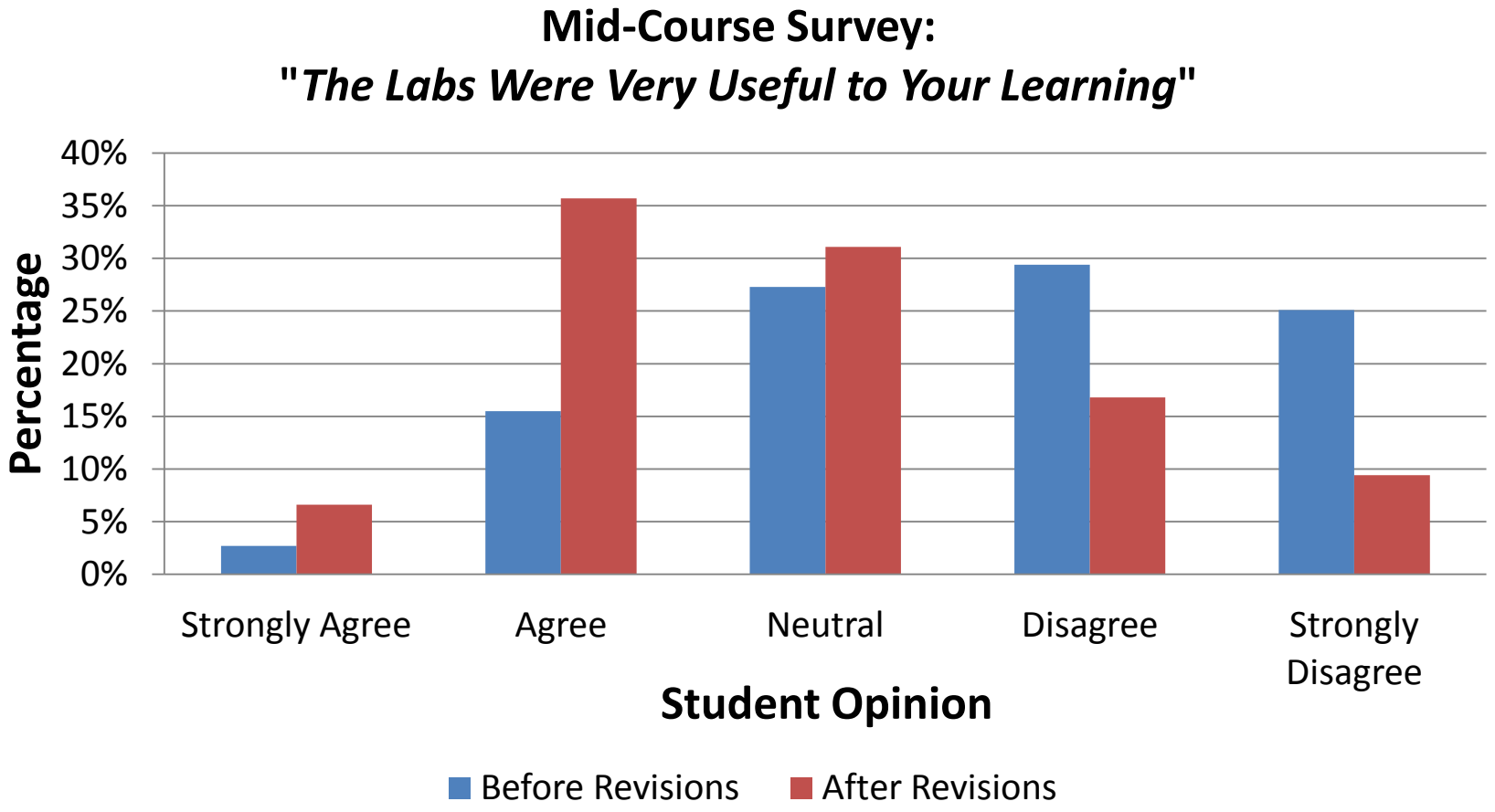
Labs: Revisions to Pre-Reading

Before	After
Pros: Detailed and possible to *stand alone* **Cons:** More emphasis was given for writing code in R rather than using R for statistical analysis Examples in the first half of the labs were context free Only some labs included pre-lab exercises	Objectives added to the beginning of the document Content kept the same, but more organized by separating into sections with appropriate headings Context rich examples added to pre-reading documents that lack context Most labs include pre-lab exercises with R code for problems that require coding

Labs: Revisions to Exercises

Before	After
Exercises in the first half of the labs were context free	Most labs include two versions of the exercises
	Questions more aligned with Learning Outcomes
	Context rich problems added
Some questions require simply obtaining output using R commands without analyzing the results	Questions encourage meaningful learning
	More lab exercises include questions that require use of graphical methods
	Not simply a repetition of the pre-lab exercises.

Labs: Student Perceptions
Pre/Post Stage 1 Revisions



Revisions to Labs: Conclusions

- Increased student satisfaction
- TA feedback on labs valuable for improving lab structure and lab material
- Impact on student learning yet to be determined

Acknowledgements

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