

An Overview of the Transformation of Statistics Courses via CWSEI

**With Highlights on
Interactive Engagement in
STAT 300, STAT 302 and STAT 305**

Gaitri Yapa ^{1,2}, Bruce Dunham ¹

¹ Department of Statistics, UBC

² Carl Wieman Science Education Initiative

Abstract

The transformation of undergraduate courses in Statistics began in 2007 and is ongoing. The recent impact on five current courses is summarised here. Highlights include moves to activity-based learning, clickers questions, group work, regular on-line homeworks, and weekly TA feedback. Data on student perceptions of certain innovations and student shifts in attitudes to Statistics are also described.

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 specialists, elective for other students
Enrolment	~ 1000 per year Multi sections of 150-350	~ 700 per year Single section of 250-350	~ 130 per year Two sections of 60-70
Offered	Each term	Each term	Each Term

Courses Newly Transformed

	STAT 300	STAT 305
Title	Intermediate Stats for Applications	Intro to Statistical Inference
Description & Audience	Intermediate course for Science students	Core course for Stat specialists, elective for other students
Enrolment	~ 100 per year Single section of ~100	~ 120 per year Single section of ~120
Offered	Term 1	Term 2

Methods Continued to be Used

Learning
Outcomes

Interventions
for
Misconceptions

Formative
Assessments

Student & TA
Feedback

Student
Engagement

Cooperative
Learning

<http://www.cwsei.ubc.ca/Files/EOY/EOY2012/Posters/StatCourseTransformation.pdf>

New Methods Being Used

Student Engagement
& Cooperative
Learning in Each
Lecture

Weekly Formative
Assessments & Faster
Feedback

Post Course
Knowledge Retention
Survey

Weekly TA Feedback

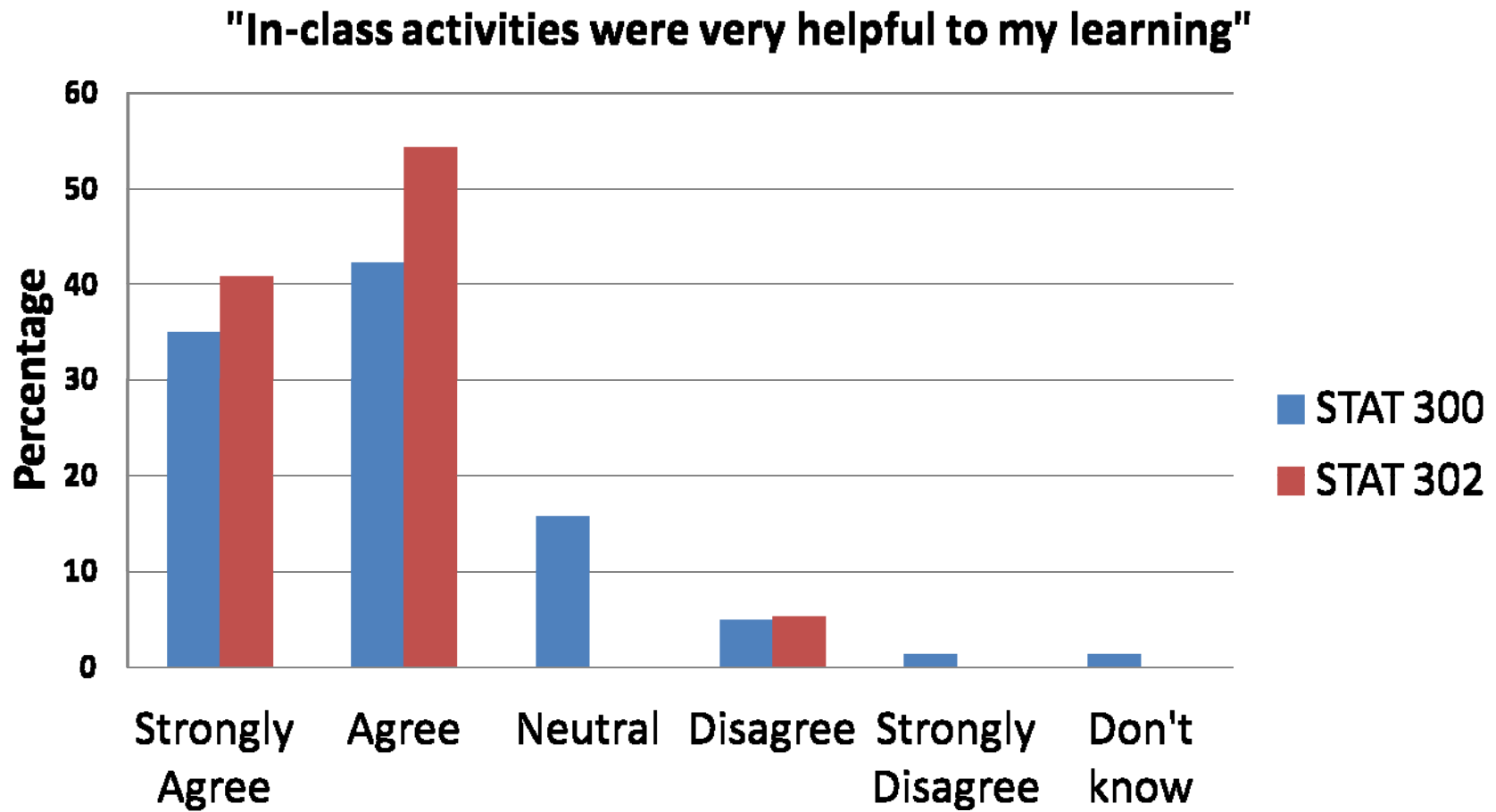
Student Engagement & Cooperative Learning in Each Lecture

- Instructor pre-selected groups, based on
 - major
 - year in program
 - gender and
 - other factors deemed important for group diversity
- Assigned seating
 - To enable group work during lectures & labs
 - See Resource Package for Example(s)

Activity-Based & Cooperative Learning in Each Lecture ...

- Activity worksheets
 - Scaffolded to guide students
 - See Resource Package for Examples
- Clicker questions to probe understanding
 - See Resource Package for Example(s)
 - Individual attempt
 - To monitor individual progress
 - To ensure accountability
 - Group attempt (when needed)
 - To provide opportunities to discuss difficulties

In-class Group Activities: Student Perceptions



In-class Group Activities: Student Perceptions ...

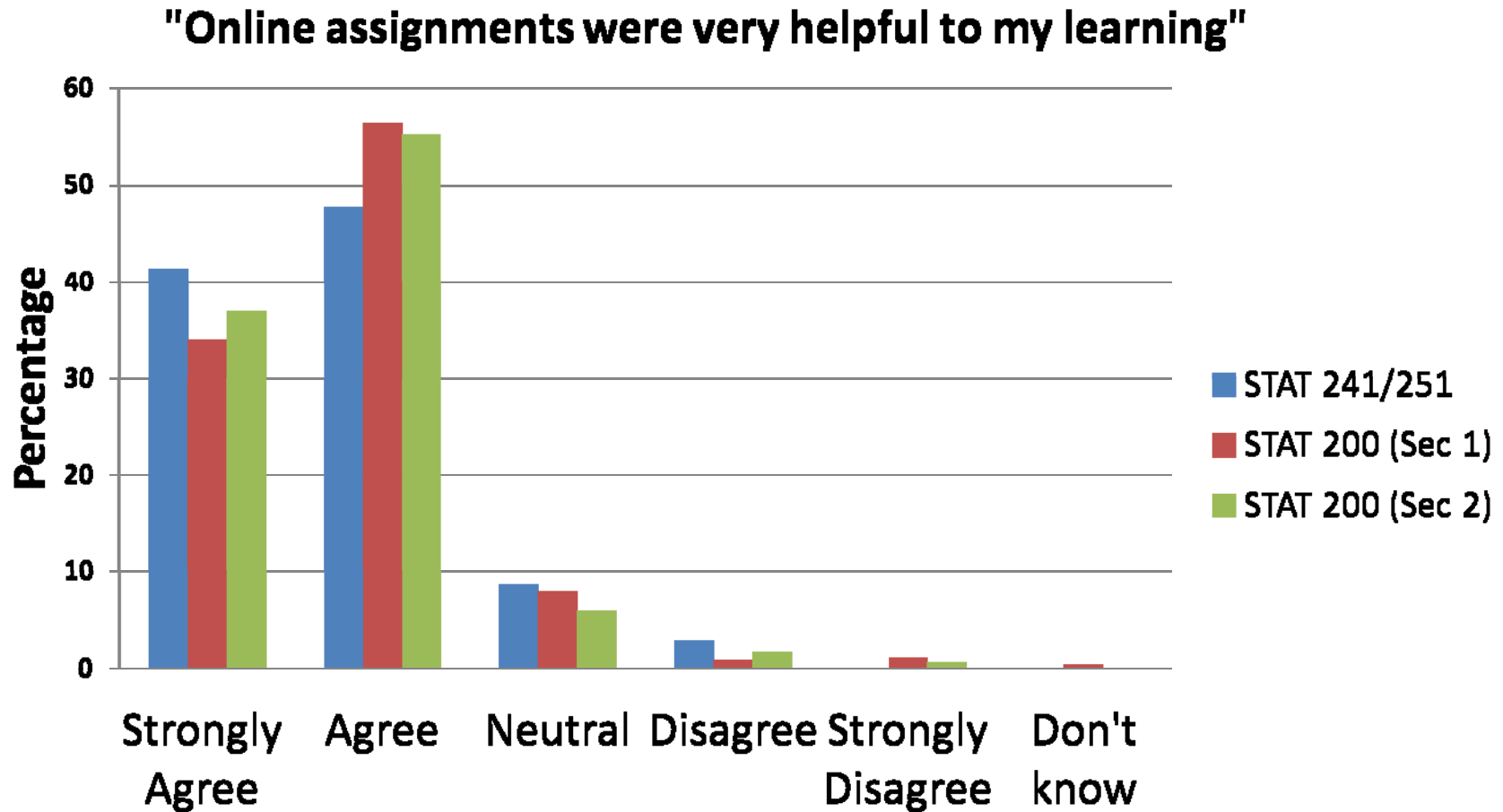
- STAT 305:
 - *At first I had a lot of growing pains with the activity-based lectures, but after sampling the style up until the first quiz, I must admit I love this system. Wish more lectures were like this!!*
 - *"The interactive hands-on approach to learning is really helping me understand the concepts and makes them 'stick' in my mind".*
- STAT 302
 - *"I think that the in-class activities are REALLY helpful (it's fun too!) It really makes me think and not waste the class time just copying down the notes. LOVE it :)".*

Weekly Formative Assessments & Faster Feedback

Weekly online assignments (via WeBWork)

- Open-source online homework system
 - free to students, unlike resources accompanying textbooks
- Student engagement with course material weekly
- Students obtain instant feedback
- Frees TA time from grading to more productive tasks
 - such as assisting instructors with in-class activities

Weekly Online Assignments: Student Perceptions



Weekly Online Assignments: Student Perceptions

- *Having the allowance of multiple attempts gives me instant feedback and letting me look through my train of thought to figure out what I did wrong and how to get the right answer ... very helpful in learning the material.*
- *Although having weekly homework can seem like a lot of work, WeBWork ensures that I am somewhat caught up with the class.*
- *I like the fact that WeBWork questions are not so lengthy in terms of its number of questions. I could finish every WeBWork assignment on time and it was a great review for the week's lectures.*
- *Questions were reflective of material taught in lecture; allowed us to practice skills and reinforce learning*

Weekly Formative Assessments & Faster Feedback ...

- Two day turn around time for written assignments in STAT 200 (Elementary Statistics for Applications)
 - Assignments collected on Friday, marked over the weekend and returned on Monday
 - ~550 students in Term 1
 - ~350 students in Term 2

Post Course Knowledge Retention Surveys

- STAT 200 (Conducted in 2006-2007)
 - Students interviewed several months after taking the course
 - Reported avg. time spent studying outside class: 3-4 hrs.
 - Mean final grade of participants: 80%
 - Performance on retention interviews: very poor, with many key concepts retained by less than 7 of the 29
 - Sample was obviously atypical – average grades on STAT 200 are much lower 80%
 - Could be presumed that
 - most students studied less than this sample, or
 - at least would have retained less post-course.

Post Course Knowledge Retention Surveys ...

- **STAT 200 Results:**
 - In line with research
 - Cramming leads to poor long-term retention.
 - Suggests need for
 - Interactive engagement during the lectures,
 - Frequent formative assessments and
 - Timely feedback
- **STAT 302 & STAT 305 Surveys:**
 - On-going 2012/2013

TA Feedback

- Weekly surveys during the first implementation
 - See Resource Package for Example(s)
- Mid-course surveys during the subsequent implementations
 - See Resource Package for Example(s)

Weekly TA Lab Feedback ...

- Goals
 - Identify current problems TAs may be facing
 - Identify current problems the students may be facing
 - Keep a record of student difficulties, to share with future Lab TAs as they prepare for labs
 - Share ideas on running labs smoothly among current Lab TAs

Weekly TA Lab Feedback ...

- Three-fold benefit:

Provides

- instructor with detailed information on student difficulties
- TAs with an opportunity to reflect on their teaching
- Instructor with an opportunity to
 - Give feedback to TAs and
 - Modify activities for future use where necessary

SLASS: Statistics Attitude Survey

- Developed and trialed in 2007 for STAT 200, validated via student interviews.
- 49 parcelled into five sets: Conceptual Understanding, Effort, Problem Solving, Real World Application, Study Skills.
- Student responses compared with expert-like responses, pre and post course.
- Pre/post %favourable aggregated over each of the five parcels. Within-student differences taken.
- Robust multivariate method applied – analogous to univariate sign test.

Attitude Survey Results Comparison

- For Spring 2008, significant shift pre to post, mostly in the wrong direction.
- For Fall 2012, a greater shift observed, but mostly in the “expert-like” direction.
- Table below indicates direction and magnitude of shifts for each category.

	CU	E	PS	RW	SK
2008	0.30	-0.10	-0.06	-0.03	-0.94
2012	0.96	-0.15	0.49	0.02	-0.41

Acknowledgements

- Prof. Will Welch
 - Instructor of STAT 305
- Prof. Paul Gustafson & Dr. Bruce Dunham
 - Co-instructors of STAT 300
- Ms. Eugenia Yu
 - Instructor of STAT 200 & STAT 302
 - TA Coordinator
- Mr. Yew-Wei Lim
 - Instructor of STAT 241/251

Acknowledgements

- STAT 305 Lab TA Team
 - Hao (Nelson) Chen, David Lee & Camila Maria Casquilho Resende
- SLASS: Andy Leung, Eugenia Yu
- STAT 241/251 Lab TA Team
 - Yunlong Nie, Yiyang Pan, Dorji Pelzom & Peijun Sang
- STAT 200 Lab TA Team
 - Jonathan Baik, Yumian Hu, Wooyong Lee & Hao (Allan) Luo