Evaluation of a Program to Improve Statistics Teaching at Two Year (Junior) Colleges

ICOTS 10 – Kyoto – July 11, 2018

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CSU - CI
Outline

• TANGO Stat Ed
• Methods and Demographics
• Results
• Conclusion
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Why “TANGO”? 
Training a New Generation of Statistics Educators (TANGO Stat Ed)

- NSF-funded grant ($571k for 3 years)
- Recruited 61 “Next Generation Instructors” (NGIs) from two year (junior) colleges

- Four components
  - Training workshops
  - Pair NGI w/mentor in stat ed community (2 hr/mo)
  - Create professional learning communities in hubs
  - Bring them into the (encouraging and nurturing) stat ed community
TANGO Stat Ed – Program Impact

Program Impact

- 4 Hubs
- 2 Grant Coordinators
- 12 Mentors
- 72 Instructors

10,000 + Students per Year
TANGO Stat Ed – Four Regional Hubs
# TANGO Stat Ed – Workshops

- Cohort 1 – USCOTS 2015, Refresher, USCOTS 2017
- Cohort 2 – Workshop in 2016, USCOTS 2017
- Connect with National Leaders and Textbook Authors

<table>
<thead>
<tr>
<th>Classroom Activities for Conceptual Understanding</th>
<th>Roxy Peck</th>
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</thead>
<tbody>
<tr>
<td>Multivariate Thinking</td>
<td></td>
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<tr>
<td>Critical Thinking</td>
<td>Roger Woodard</td>
</tr>
<tr>
<td>Assessment Tools</td>
<td>Bob delMas</td>
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<tr>
<td>Student Misconceptions</td>
<td>Tim Jacobbe</td>
</tr>
<tr>
<td>Reading the Stat Ed Literature</td>
<td>Bob delMas &amp; Tim Jacobbe</td>
</tr>
<tr>
<td>Promoting Conceptual Understanding</td>
<td>Kari Lock Morgan</td>
</tr>
<tr>
<td>The Birth of an Activity</td>
<td>Beth Chance</td>
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</tbody>
</table>
Why Two-Year Colleges?

- 277k students take intro stat per year at 2YC
- USCOTS 2017: “Test Your Knowledge about the Two Year College” Poster & Beyond
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<table>
<thead>
<tr>
<th></th>
<th>Actual Value</th>
<th>2YC Guess</th>
<th>4YC Guess</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of stat students taught at 2YC</td>
<td>66%</td>
<td>60%</td>
<td>49%</td>
</tr>
<tr>
<td>% growth in stat enrollment at 2YC (note: 23% at 4YC)</td>
<td>102%</td>
<td>57%</td>
<td>54%</td>
</tr>
<tr>
<td>% of 2YC stat instructors w/stat degree</td>
<td>5%</td>
<td>6%</td>
<td>10%</td>
</tr>
<tr>
<td>% of 2YC stat section taught by part-timers</td>
<td>21%*</td>
<td>63%</td>
<td>64%</td>
</tr>
</tbody>
</table>
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Methods

• Surveys pre-/post-participation in TANGO Stat Ed
• Statistics Teaching Inventory (STI) (Zieffler, Park, Garfield, delMas, & Bjornsdottir, 2012), augmented with additional questions
  – Likert-type: Paired t-test, Wilcoxon Signed Rank test, Weighted kappa (concordance)
  – Dichotomous: McNemar’s test
  – Explored concordance (weighted kappa) as well
• Self-evaluation of changes from TANGO Stat Ed
• Structured interviews by external evaluator
  – Not presented here
Topics of Survey Questions

• Instructional method
  – Lecture, group activities, technology, etc.
• Discussions with students
  – Quality of data, variability, etc.
• Assessments – type and purpose
• Beliefs about teaching intro stat
  – Topics, effective pedagogy, assessment, etc.
• Alignment with GAISE guidelines
## Demographics

<table>
<thead>
<tr>
<th>Question</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respondents</td>
<td>57 Pre, 31 Post, 30 Both Pre and Post</td>
</tr>
<tr>
<td>Class Size</td>
<td>Mean = 33, Range = 16 – 50</td>
</tr>
<tr>
<td>Math Prerequisite</td>
<td>Mostly high school or intermediate algebra</td>
</tr>
<tr>
<td>Have Teaching Assistant</td>
<td>4% yes</td>
</tr>
<tr>
<td>Constraints to Improve</td>
<td>58% personal time 46% student characteristics 11% value placed on teaching 47% department 46% technology 26% other</td>
</tr>
<tr>
<td>Position</td>
<td>36% tenured, 32% tenure-track, 26% adjunct</td>
</tr>
<tr>
<td>Years Teaching Intro Stat</td>
<td>Mean = 7.4, Range = 0 - 32</td>
</tr>
<tr>
<td>Graduate Coursework</td>
<td>Theory – 19% none, 18% 5+ Applied – 45% none, 17% 5+</td>
</tr>
<tr>
<td>Hours/Month with Mentor</td>
<td>Mean = 1.3, range = 0 - 4</td>
</tr>
</tbody>
</table>
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Results – Likert-type

Survey Question:
- Belief - Use Tech
- Belief - Prob Rules
- Discuss Variability Import
- Lectures
- Discussions
- Tech - Concepts
- Belief - Produce
- Belief - Prob Distn
- Literacy
- Discuss Data Quality
- Work Out Probs
- Reviewed
- Hand Calculate
- Activities
- Exams
- Real Data
- Belief - Collect
- Discuss Decisions w/ Data
- Projects
- Belief - Lect > Activ
- Tech - Analyze
- Open-Ended
- Belief - Tables
- Belief - Depth

T-Value
- Negative
- Positive

Paired t-test value

Values range from -2 to 4.
<table>
<thead>
<tr>
<th>Question</th>
<th>Mean Pre</th>
<th>Mean Post</th>
<th>p-value (t)</th>
<th>p-value (WSR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology tools should be used to illustrate most abstract statistical concepts.</td>
<td>3.54</td>
<td>3.93</td>
<td>0.001</td>
<td>0.002</td>
</tr>
<tr>
<td>Rules of probability should be included in an introductory statistics course.</td>
<td>3.28</td>
<td>2.72</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>The study of variability is at the core of statistics.</td>
<td>3.42</td>
<td>3.94</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>Teacher presentation (lectures, demonstrations, etc.) are used to help students learning statistics</td>
<td>4.23</td>
<td>3.68</td>
<td>0.01</td>
<td>0.02</td>
</tr>
<tr>
<td>Small group class discussions are used to help students learn statistics</td>
<td>3.26</td>
<td>3.48</td>
<td>0.01</td>
<td>0.02</td>
</tr>
<tr>
<td>Students use technology tools to help them understand statistical concepts.</td>
<td>3.36</td>
<td>3.74</td>
<td>0.04</td>
<td>0.04</td>
</tr>
<tr>
<td>Students should learn methods for producing data (e.g., designing an experiment).</td>
<td>3.35</td>
<td>3.52</td>
<td>0.04</td>
<td>0.04</td>
</tr>
<tr>
<td>The topic of theoretical probability distributions (e.g., the binomial distribution) should be included in an introductory statistics course.</td>
<td>3.30</td>
<td>2.72</td>
<td>0.04</td>
<td>0.053</td>
</tr>
</tbody>
</table>
My assessments include a component in which students are required to collaborate (e.g., group project, group quiz). 58% => 77%
Self-Evaluation of Changes

- 73% improved attitude towards statistics
- 93% improved attitude towards statistics education
- 87% improved statistics content knowledge
- 97% improved statistics pedagogy knowledge
- 3% said teach same way after TANGO Stat Ed
(Selected) Testimonials

• I've completely changed how I'm teaching [and assessing] statistics….I can't thank you enough for opening up the stat ed community to me.

• [Now] we do activities in class EVERY day and I lecture much less. Students are more engaged in class and they seem to be learning more deeply, especially when it comes to inference and the CLT.

• …leaders were amazing, inspiring and ready to help us make new connections.

• The workshops and the community aspect of the TANGO Stat Ed group were most compelling. Mentors and mentees are so close-knit and helpful.

• Having been a part of this for two years, each time I have met with others in person has the most lasting impression on me. I come away from those interactions completely energized!
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TANGO Stat Ed – Conclusions

NGIs beliefs and pedagogy aligned more with modern statistics pedagogy

Inspired future leaders in the TYC community

Created a community

– Website, they volunteered to manage a Zoom room, an OER Commons group, a Goodreads group, etc.

– TANGO Stat Ed lunch at AP Stat reading

• Created leadership stream
  – Workshops at CSE, CMC3, AMATYC 2018 led by NGIs

• Created the *beginning* of a structure for Stat Ed PD

• Encouraged to apply for next scale grant
If you would attain to what you are not yet, you must always be displeased by what you are. For where you are pleased with yourself there you have remained. Keep adding, keep walking, keep advancing.

~Saint Augustine

IF YOUR PLAN IS FOR ONE YEAR, PLANT RICE.

IF YOUR PLAN IS FOR TEN YEARS, PLANT TREES.

IF YOUR PLAN IS FOR ONE HUNDRED YEARS, EDUCATE CHILDREN.

CONFUCIUS