Stepping Outside Classroom Walls

Designing Experiences for Teachers in a Massive Open Online Course [MOOC] on Teaching Statistics

Hollylynne S. Lee
IASE Satellite Conference
Rio de Janeiro, Brazil
July 24, 2015
http://tinyurl.com/iase15-hslee

THE WILLIAM & ANN
FRIDAY INSTITUTE
FOR EDUCATIONAL INNOVATION

TO USE INVESTIGATION CYCLES TO TEACH STATISTICS...

Background

- Part of series of 6 MOOC-Eds at NC State's *Friday Institute for Educational Innovation*
  - funded by Hewlett Foundation
  - use custom-made platform--*not* Coursera, EdX, etc...
- Support and development staff
- Free software donation from Pearson for StatCrunch
- Tech support from TUVA
- Many free resources from ASA
- Advertising help from ASA, IASE, NCTM

Designing for Online Learning

An old hat for many...
But for some,
Its a Brave New World

The World of Designing for MANY Teachers' Learning Online

Free and open access

Personalized

accounts for classroom variation

creates a community of professional learners

does not assume strong statistical knowledge

includes strong contributions by, and presence of, the instructor

is not tied to US state or country curriculum

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Why do a MOOC on Teaching Statistics?

Introduce teachers to:

- framework to guide instruction and assessment
- technology tools
- websites for great data (e.g., Census at Schools)
- quality tasks and lesson plans
- classroom ready videos
- easy to read articles
- colleagues around the world teaching statistics to children, adolescents, or adults

So teachers can help students

- ask questions about real data
- engage in investigative cycles
- develop statistical habits of mind
- utilize power of technology
- develop sophistication with statistics over time

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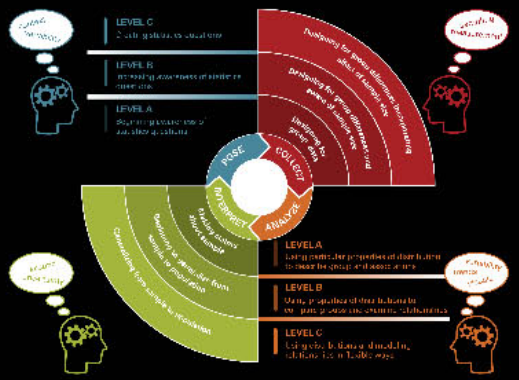
Design Principles

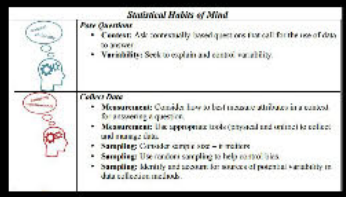
- foster self-directed learning
- foster peer-supported learning
- use authentic learning experiences grounded in practice
- integrate multiple voices
- support crowdsourcing and use of open education resources

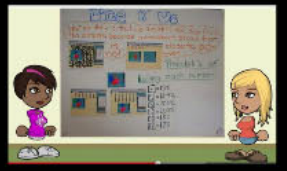
Design Challenge 1: Create Framework for Teachers

Adapted from the GAISE framework endorsed by American Statistical Association 2005

Extended to include recent research and integrate habits of mind







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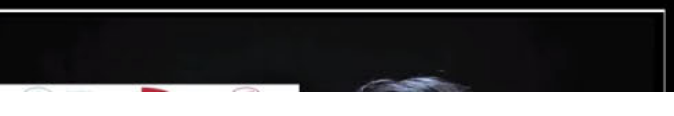

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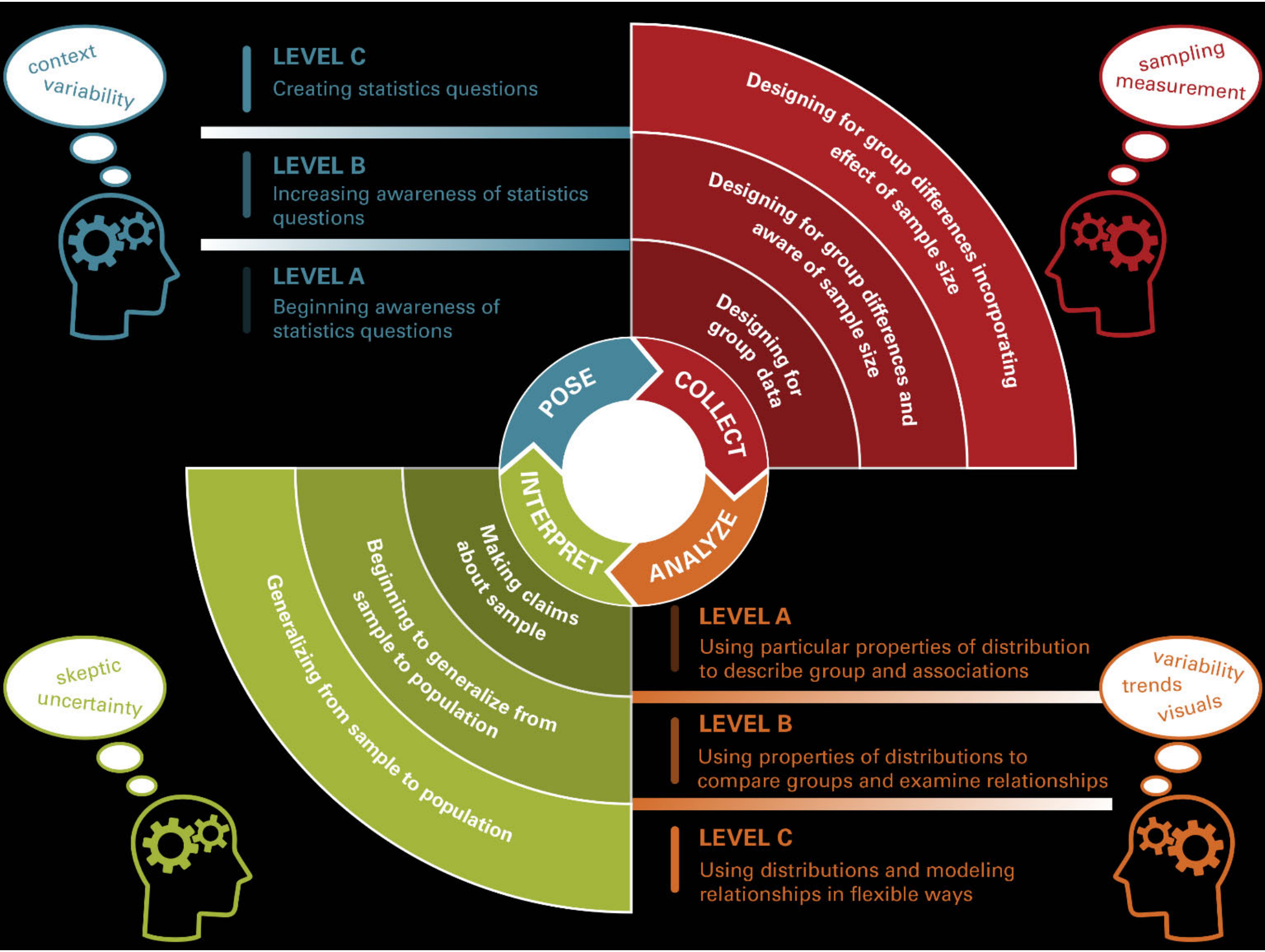
context
variability
LEVEL C
Creating statistics questions
LEVEL B
Increasing awareness of statistics questions
LEVEL A
Beginning awareness of statistics questions
Designing for group differences incorporating effect of sample size
Designing for group differences and aware of sample size
Designing for group data
sampling
measurement
POSE
COLLECT
ANALYZE
INTERPRET
Making claims about sample
Beginning to generalize from sample to population
Generalizing from sample to population
skeptic
uncertainty
LEVEL A
Using particular properties of distribution to describe group and associations
LEVEL B
Using properties of distributions to compare groups and examine relationships
LEVEL C
Using distributions and modeling relationships in flexible ways
variability
trends
visuals

Statistical Habits of Mind

Pose Questions

- **Context:** Ask contextually-based questions that call for the use of data to answer.
- **Variability:** Seek to explain and control variability.

Collect Data

- **Measurement:** Consider how to best measure attributes in a context for answering a question.
- **Measurement:** Use appropriate tools (physical and online) to collect and manage data.
- **Sampling:** Consider sample size – it matters.
- **Sampling:** Use random sampling to help control bias.
- **Sampling:** Identify and account for sources of potential variability in data collection methods.


LEVEL C
LEVEL B
LEVEL A
POSE
COLLECT
ANALYZE
LEVEL A
LEVEL B
LEVEL C

Schoolopoly Task

For Students

Schoolopoly: Is the die fair or biased?

Background

Suppose your school is planning to create a board game modeled on the classic game of Monopoly. The game is to be called Schoolopoly and, like Monopoly, will be played with dice. Because many copies of the game expect to be sold, companies are competing for the contract to supply dice for Schoolopoly. Some companies have been accused of making poor-quality dice, and these are to be avoided, since players must believe the dice they are using are actually "fair." Each company has provided dice for analysis, and you will be assigned one company to investigate:

Luckytown Dice Company
Dice 'R' Us
High Rollers, Inc.
Dice, Dice, Baby!
Pips and Dots
Slice 'n' Dice

Your Assignment

Working with a partner, investigate whether the dice sent to you by the company is *fair* or *biased.* That is, collect data to infer whether all six outcomes are equally likely and answer the following questions:

1. Do you believe the dice you tested are fair or biased? Would you recommend that dice be purchased from the company you investigated?
2. What *compelling evidence* do you have that the dice you tested are fair or unfair?
3. Use your data to estimate the probability of each outcome, 1-6, of the dice you tested.

Dice R Us

What we think is that we shouldn't buy dice from this company because our evidence shows that

is not

close to, but even.

Probability of Rolling each number:

-  =13%
-  =18.4%
-  =17.8%
-  =20.8%
-  =18%
-  =12%

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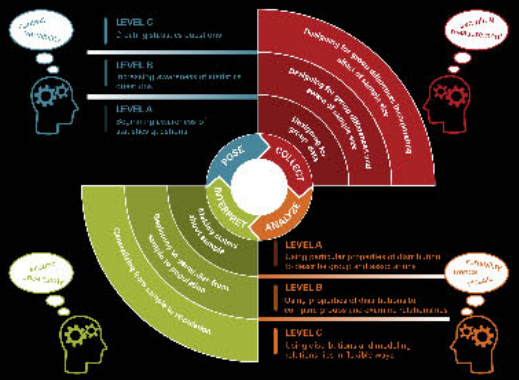
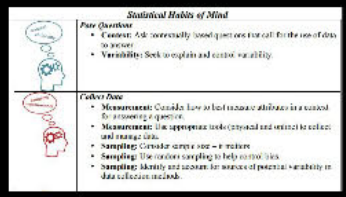
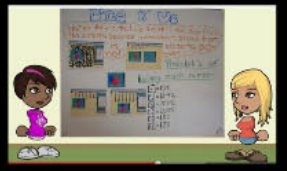




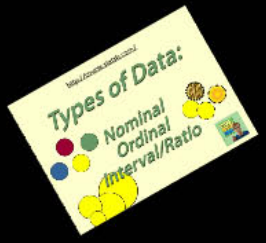


Design Challenge 2: Integrate Multiple Voices

Expert Panel speaking from different perspectives:
Susan Friel (UNC-CH),
Webster West (NC State),
Chris Franklin (UGA)

"Working interviews" with the Experts

Essential resources included brief excerpts from papers or video clips from others



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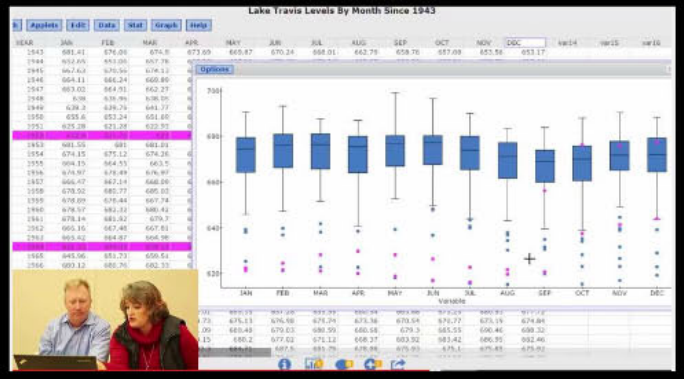

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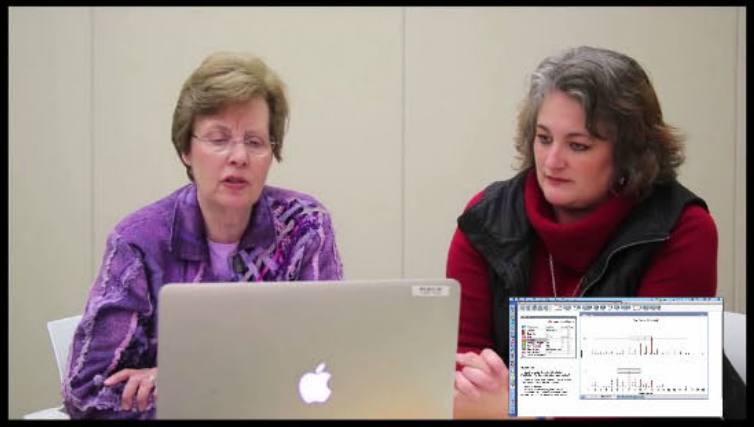

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http://course.statslc.com/

Types of Data:

Nominal
Ordinal
Interval/Ratio

What Makes a Good Question?

The following is a direct excerpt from pages 8-11 in the article:

Pfannkuch, M., Regan, M., Wild, C. J., & Horton, N. J. (2010). Telling data stories: Essential dialogues for comparative reasoning. *Journal of Statistics Education*, *18*(1), 1-38.

You can access the article here: http://www.amstat.org/publications/jse/v18n1/pfannkuch.pdf

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In dialogues with data we create meaning from images by making sense of and verbalizing in words what we see and understand (Bakker, 2004; Makar & Confrey, 2005). Therefore two key components for promoting statistical reasoning are *image* and *language*. To determine what makes a good question we need to address: Does the language used invoke an image which *shows* what the question is asking and does this image highlight *exactly* what we need to find out about to be able to answer the question? Does the investigative question ask what we really mean (Arnold, 2008)? To answer these questions the use of precise language is critical and vocabulary and sentence structure are important.

Our investigative question in the guide, "Do right foot lengths for 13 year-old NZ boys tend to be bigger than right foot lengths for 13 year-old NZ girls?", ensures there is a strong link between the precise language used and a mental picture. The question is structured with the key

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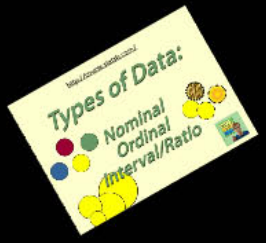
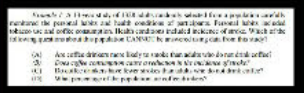
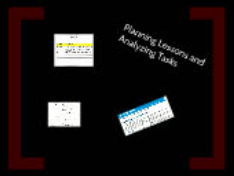


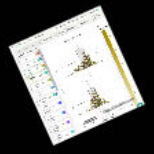
Design Challenge 3: Authentic Learning from Practice

Consider conceptual assessment items by taking the LOCUS test



http://locus.statisticseducation.org





Opportunity to develop a project to implement in their classroom

Consider conceptual assessment items by taking the LOCUS test

Example 1: A 13-year study of 1328 adults randomly selected from a population carefully monitored the personal habits and health conditions of participants. Personal habits included tobacco use and coffee consumption. Health conditions included incidence of stroke. Which of the following questions about this population CANNOT be answered using data from this study?

(A) Are coffee drinkers more likely to smoke than adults who do not drink coffee?
(B) Does coffee consumption cause a reduction in the incidence of stroke?
(C) Do coffee drinkers have fewer strokes than adults who do not drink coffee?
(D) What percentage of the population are coffee drinkers?

http://locus.statisticseducation.org

Animations and videos that illustrate students' work on tasks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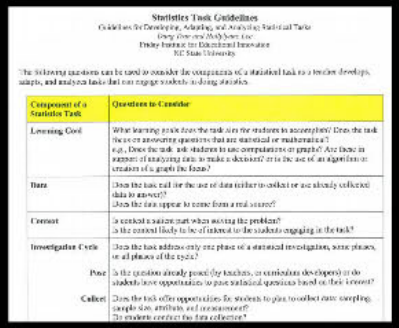
Planning Lessons and Analyzing Tasks



Statistics Task Guidelines

Guidelines for Developing, Adapting, and Analyzing Statistical Tasks

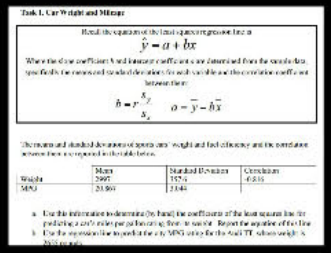
Every Dot and Molly Sears, LLC

Friday Institute for Educational Innovation

NC State University

The following questions can be used to consider the components of a statistical task as a teacher develops, adapts, and analyzes tasks that can engage students in doing statistics.

Component of a Statistics Task	Questions to Consider
Learning Goal	What learning goals does the task aim for students to accomplish? Does the task focus on answering questions that are statistical or mathematical? e.g., Does the task ask students to use computations or graphs? Are these in support of analyzing data to make a decision? or is the use of an algorithm or creation of a graph the focus?
Data	Does the task call for the use of data (either to collect or use already collected data to answer)? Does the data appear to come from a real source?
Context	Is context a salient part when solving the problem? Is the context likely to be of interest to the students engaging in the task?
Investigation Cycle	Does the task address only one phase of a statistical investigation, some phases, or all phases of the cycle?
Pose	Is the question already posed (by teachers, or curriculum developers) or do students have opportunities to pose statistical questions based on their interest?
Collect	Does the task offer opportunities for students to plan to collect data: sampling, sample size, attributes, and measurement? Do students conduct the data collection?



Task 1. Car Weight and Mileage

Recall the equation of the least-squares regression line is

$$\hat{y} = a + bx$$

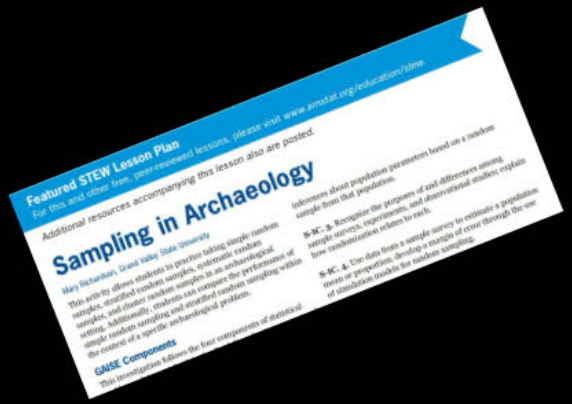
Where the slope coefficient b and intercept coefficient a are determined from the sample data, specifically the means and standard deviations for each variable and the correlation coefficient between them:

$$b = r\frac{s_y}{s_x} \qquad a = \bar{y} - b\bar{x}$$

The means and standard deviations of sports cars' weight and fuel efficiency and the correlation between them is computed in the table below.

	Mean	Standard Deviation	Correlation
Weight	2905	357.6	-0.816
MPG	23.861	3.144	

a. Use this information to determine (by hand) the coefficients of the least squares line for predicting a car's miles per gallon using from its weight. Report the equation of the line.
b. Use the regression line to predict the city MPG rating for the Audi TT, whose weight is 2932 pounds.



Featured STEW Lesson Plan

For this and other free, peer-reviewed lessons, please visit www.amstat.org/education/stew

Additional resources accompanying this lesson also are posted.

Sampling in Archaeology

Mary Richardson, Grand Valley State University

This activity allows students to practice taking simple random samples, stratified random samples, systematic random samples, and cluster random samples in an archaeological setting. Additionally, students can compare the performance of simple random sampling and stratified random sampling within the context of a specific archaeological problem.

GAISE Components

This investigation follows the four components of statistical inferences about population parameters based on a random sample from that population.

S-IC.3. Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.

S-IC. 4. Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling.

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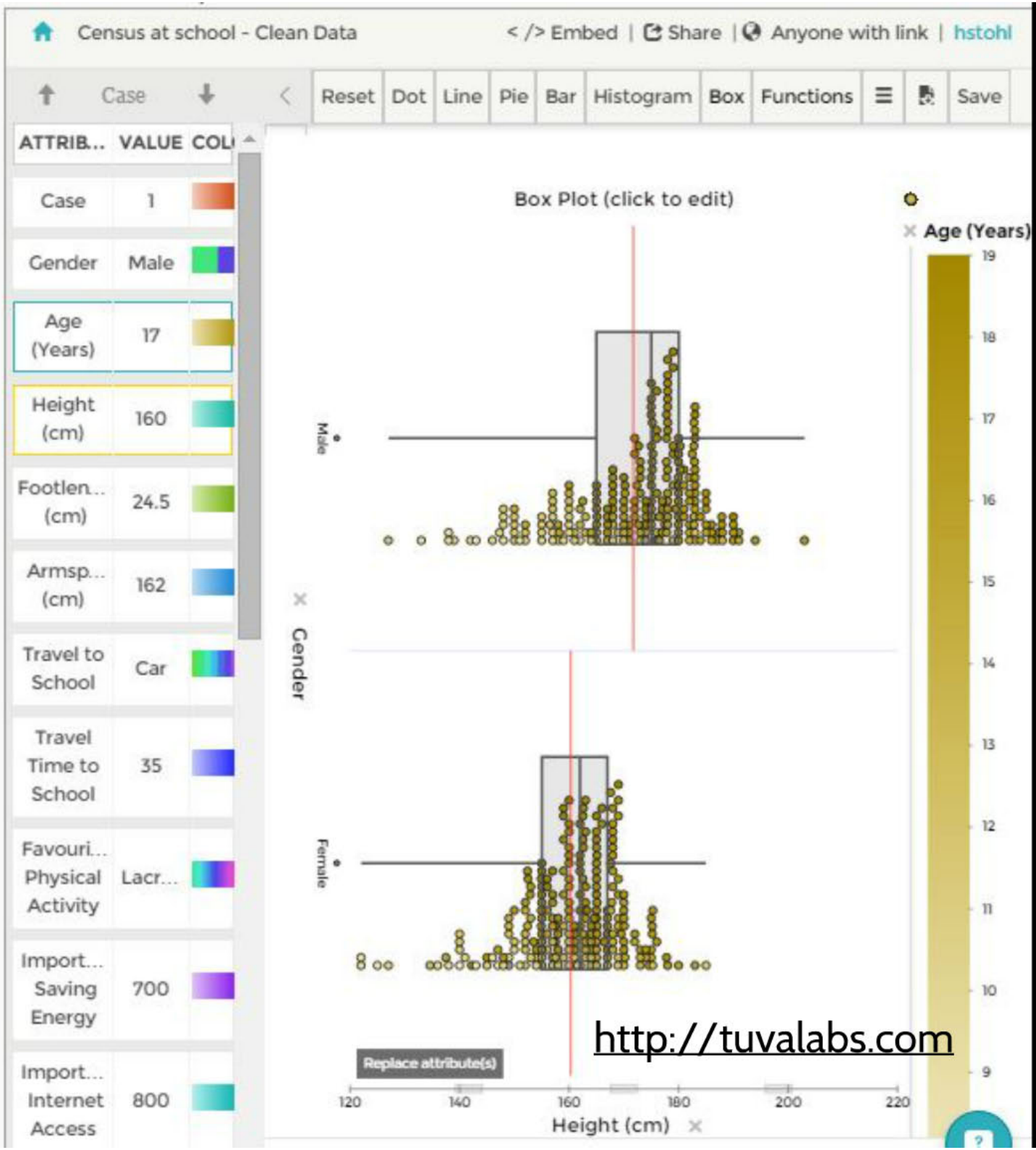
Using Census at Schools

http://www.amstat.org/censusatschool


Census at school - Clean Data
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Case
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VALUE
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Case 1
Gender Male
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Height (cm) 160
Footlen... (cm) 24.5
Armsp... (cm) 162
Travel to School Car
Travel Time to School 35
Favouri... Physical Activity Lacr...
Import... Saving Energy 700
Import... Internet Access 800
Box Plot (click to edit)
Age (Years)
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Height (cm)
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http://tuvalabs.com

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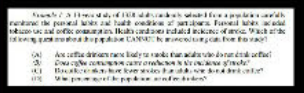

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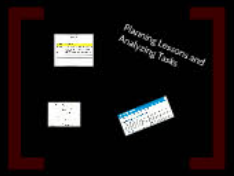
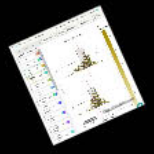
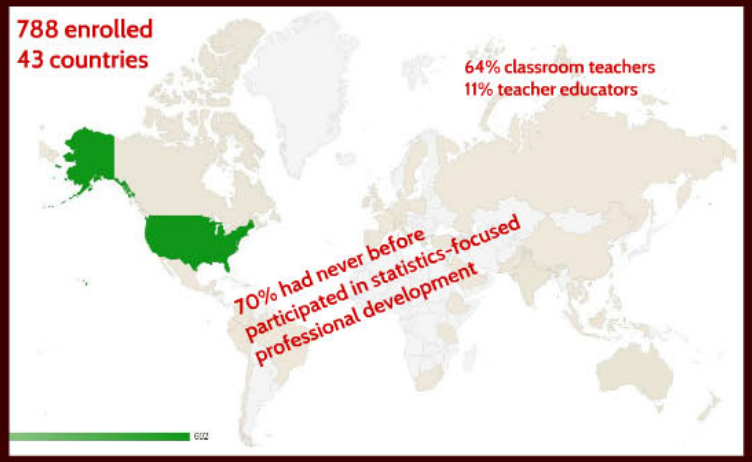




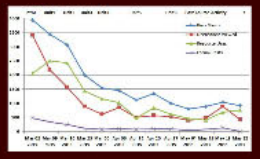
Opportunity to develop a project to implement in their classroom

Preliminary Results



589 engaged in some way at beginning of course

- 197 (33%) active in discussion forum (at least 2 posts)
- 142 engaged in final unit (24%)
- strong sense of community developed among participants

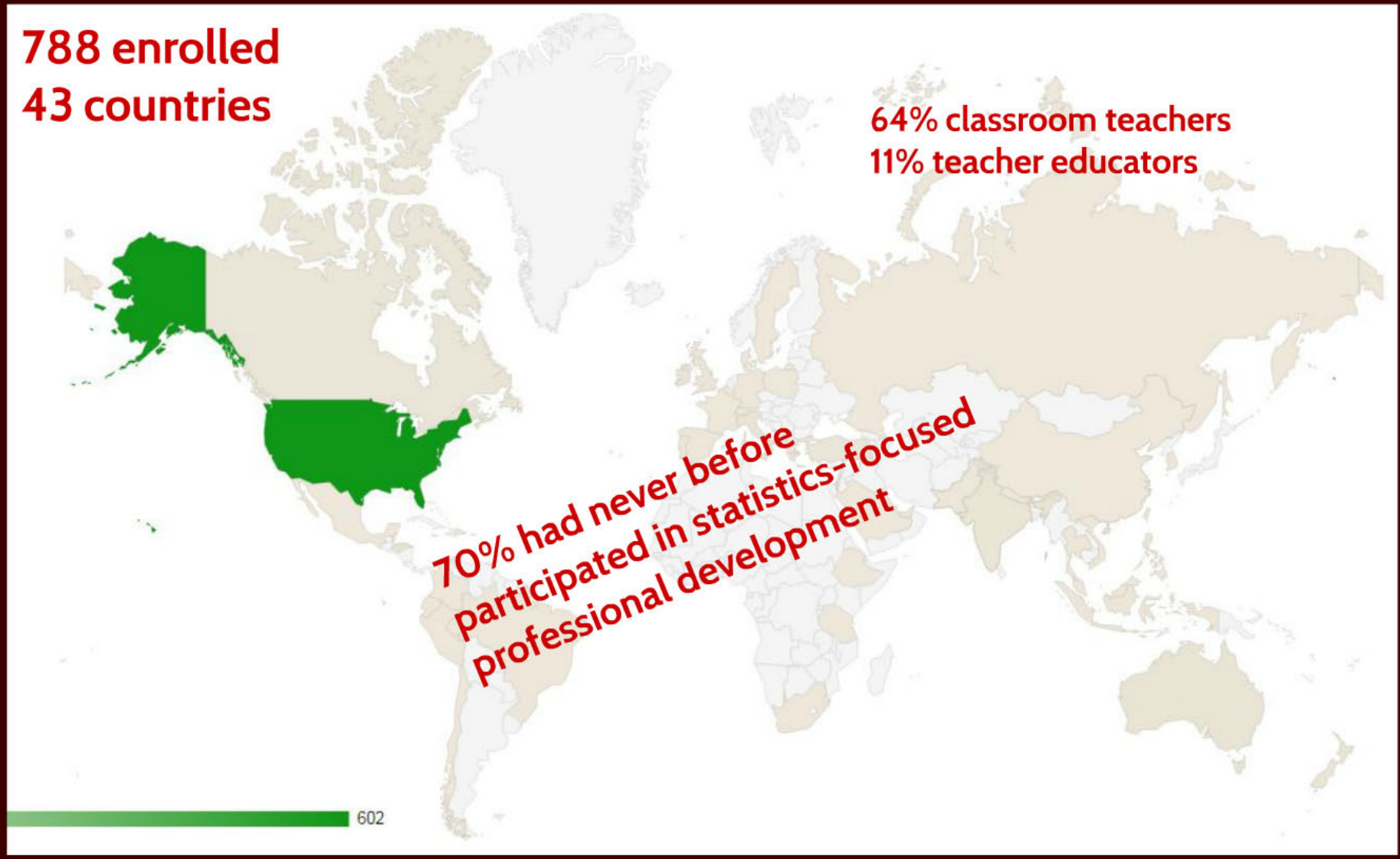


Course serves as a trigger for future professional development in statistics
Two examples:

"As I am a teacher educator, I have been passing on what I have learned in activities and presentations to teachers."

Instructor in Honduras creating faculty development workshops using TSDI MOOC materials and translating all to Spanish

Resource Name	# Clicks	# Ratings	Mean 5-star Rating	Mode 5-star Rating
Diagram: Clickable SASI Framework	150	86	4.151	4
Text: Describing SASI Framework	234	101	4.366	5
Video: Illustrating SASI framework	>188	127	4.339	5
Text: Statistics Task Guidelines	154	65	3.950	4
Example Investigation Task: Schoolopoly	193	50	3.840	4
Animated Video: Students' work showing levels of sophistication	151	42	3.810	4
Animated Video: Students' work with a dynamic simulation tool	174	48	3.790	4


788 enrolled
43 countries
64% classroom teachers
11% teacher educators
70% had never before participated in statistics-focused professional development
602

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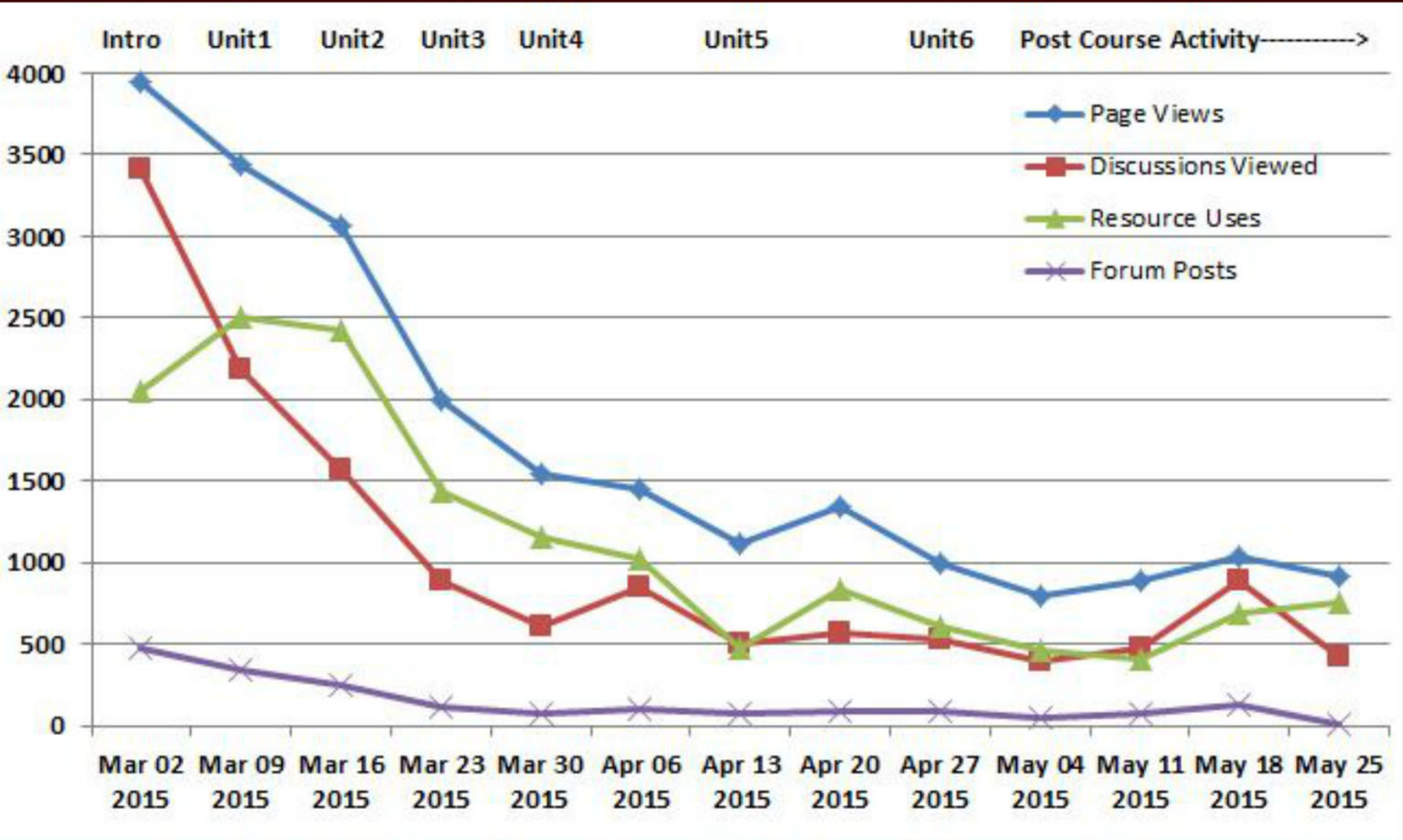
- 142 engaged in final unit (24%)
- strong sense of community developed among participants


Intro
Unit1
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4000
3500
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Mar 02 2015
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Apr 20 2015
Apr 27 2015
May 04 2015
May 11 2015
May 18 2015
May 25 2015

Resource Name	# Clicks	# Ratings	Mean 5-star Rating	Mode 5-star Rating
Diagram: Clickable SASI Framework	150	86	4.151	4
Text: Describing SASI Framework	234	101	4.366	5
Video: Illustrating SASI framework	>188	127	4.339	5
Text: Statistics Task Guidelines	154	65	3.950	4
Example Investigation Task: Schoolopoly	193	50	3.840	4
Animated Video: Students' work showing levels of sophistication	151	42	3.810	4
Animated Video: Students' work with a dynamic simulation tool	174	48	3.790	4

Course serves as a trigger for future professional development in statistics
Two examples:

"As I am a teacher educator, I have been passing on what I have learned in activities and presentations to teachers."

Instructor in Honduras creating faculty development workshops using TSDI MOOC materials and translating all to Spanish

Classroom Impacts and Their Triggers

"I have changed my planing process for statistics. I will use more technology in my teaching and spend more time on the fist 2 phases of the investigative cycle. I will encourage statistical habits of mind and movement through the levels of the SASI framework."

"1. Adopt and use the habits of mind. 2. Use the SASI framework. 3. Use data visualization tools. 4. Tell all the teachers I can about what I learned in the mooc."

*"I used to worry about giving students **data that was messy and realistic**. Now, I look forward to these opportunities because they prompt **interesting conversations** and engage my students."*

"I rely even more on visualization of data. And I use more real life data in class."

"I will utilize the cycle more in my classroom. I will definitely apply some of the resources like the Census in Schools website."

"I will go beyond the textbook, introducing other resources and making sure that the emphasis is on the interpretation of the data and the research question, not just on the computation."

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Acknowledgments

Shout-Out to:

- my co-designers: Dr. Dung Tran, Theresa Gibson, Jennifer Lovett, Tasha Elliott
- the magic makers: Mark Samberg, Alex Dreier, Benjamin Robinson
- Glenn Kleiman and the Hewlett Foundation for making this possible!

Thank you to organizations such as ASA and IASE for helping to spread the word!

Todd Lee, my family, colleagues, and friends for all their support and putting up with my insane schedule and listening to my ideas!

Help spread the word and join us in the fall.

We launch September 28th!

http://www.mooc-ed.org/tsdi

Important links and references

YOUTUBE Playlists of course videos

TSDI-Unit Introduction Videos
https://www.youtube.com/playlist?list=PLG6iFkLydgaoycUA2REsJ9Qfhq-jK4JFE

TSDI-Expert Panel in Statistics Education
https://www.youtube.com/playlist?list=PLG6iFkLydgarS6rnuPUOr3mJdZPYQLhly

TSDI-Animated Illustrations of Students' Statistical Reasoning
https://www.youtube.com/playlist?list=PLG6iFkLydgapK5YqVVqzWMSXja4ZvOPKx

TSDI-Instructional Support Videos in Statistics Education
https://www.youtube.com/playlist?list=PLG6iFkLydgaqqtfZf9psTZsuWyAyDA7-h

In September 2015, read a column written by myself and Dalene Stangl about both of our MOOCs in ASA's CHANCE magazine! http://chance.amstat.org/

Breaking Wall image: http://il6.picdn.net/shutterstock/videos/7239058/thumb/7.jpg

Stepping Outside Classroom Walls

Designing Experiences for Teachers in a Massive Open Online Course [MOOC] on Teaching Statistics

Hollylynne S. Lee
IASE Satellite Conference
Rio de Janeiro, Brazil
July 24, 2015
http://tinyurl.com/iase15-hslee

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