Teaching Teachers to Lead Statistical Investigations with Technology

AMTE 2019
Participant Goals

• Learn about the ESTEEM project’s goals and teacher education materials
• Conduct a statistical investigation of a roller coaster data set using CODAP
• View video of secondary students’ statistical investigation of the same data set
• Discuss and analyze PSTs’ discussion of students working with CODAP with same data set
• Discuss and analyze PSTs’ culminating statistical investigations of the same data set
Preservice teachers feel least prepared to teach statistics

Lovett & Lee, 2017
Goals of ESTEEM

1. **Create online** resources for statistics preservice teacher education
   - Develop CODAP as an easy to use tool to support high school statistics
   - Create classroom videos of statistics teaching and learning
   - Develop rich multivariate data tasks
   - Orchestrate video interviews with experts in statistics education

2. Design modules and approaches for using these online resources

3. Implement resources and modules in undergraduate mathematics teacher education programs.
Module 1: Foundations
Core ideas about teaching statistics and how to support students’ investigations
Two Parts (8-9 hrs each)

Module A: Inferential Reasoning
Part 1 (6-7 hrs)
Part II (TBD)

Module B: Statistical Association
Part I (5 - 6 hrs)
Part II (TBD)

Task Design Assignment
In foundation module, PSTs have many learning opportunities to:

- understand an investigative cycle,
- why it is important,
- how larger data sets and technology tools support investigations, and
- how to teach using the cycle as an anchor.
Focus for Today

Statistics investigation with CODAP from the Foundational Module
Video of students engaged with same investigation
What PSTs notice about students’ investigation and use of CODAP
How PSTs illustrate investigating data for their future students
CODAP

https://codap.concord.org/
Roller Coaster Investigation

https://tinyurl.com/RC-AMTE
A glimpse at how students investigate

A pair of 7th graders investigate the relationship between drop, top speed and type

https://youtu.be/Y6aYNDnbIAY
DISCUSSION FORUM: Examining Students’ Work on the Roller Coaster Task

- WATCH: PSTs watched and analyzed the video documenting classrooms where secondary students did CODAP-based investigations of the roller coaster data set that you just watched.
- DISCUSS: In a forum, they held a discussion to analyze the video centered around 3 analysis questions.

- For this presentation, we will focus on their responses to this analysis question:

Q2. Students used several visual and numerical representations to make sense of the data. In what ways did features in CODAP support or hinder students’ statistical reasoning? Explain.
SUPPORTED students’ statistical reasoning

Analyzing large data sets with many variables

“The features in CODAP were supportive of statistical reasoning by allowing students to look at a large set of data and make graphs that would take hours to draw by hand.”
Linked representations help support analysis

“As students explore in one graph, the points which are highlighted in one graph are then also highlighted in the other graphs and the table as well as allowing the students to see how certain statistics interact with other sets of attributes. For example, when the sixth graders were working with the top speed and the drop, the point was highlighted in all representations on the screen, allowing them to see that the point which had the top speed also had the largest drop.”
SUPPORTED students’ statistical reasoning

CODAP prompted students to pose questions

“In the upper grades, it allowed them to compare even more than just two attributes, and to easily compare different aspects of coasters to find an interesting investigative question.”
CODAP creates graphs fast, so students’ can focus on analysis.

“CODAP allowed all the students to create graphs quickly to effectively represent the data. They spent less time working on creating the graphs and more time analyzing and interpreting them. The younger groups used CODAP to learn about different relationships between variables, and the older groups used the graphs to arrive at a statistical question about the data.”
HINDERED students’ statistical reasoning

Since students don’t make the graphs by hand and it’s so easy to make graphs, they
(1) don’t choose the best graph to make
(2) make graphs that are not useful
(3) don’t understand what they mean
HINDERED students’ statistical reasoning

Since students don’t make the graphs by hand and it’s so easy to make graphs, they

(1) don’t choose the best graph to make
(2) make graphs that are not useful
(3) don’t understand what they mean

“The 6th grade students were trying to compare two different graphs each with one variable instead of combining the variables into one graph to see the relationship between the two. I think that the CODAP almost had too much freedom for the 6th graders because they didn’t seem to understand how to set up the graphs so that they could see trends.”
Since students don’t make the graphs by hand and it’s so easy to make graphs, they

1. don’t choose the best graph to make
2. **make graphs that are not useful/meaningful**
3. don’t understand what they mean

“Some disadvantages I think using CODAP might have is that students can get so caught up in how many different graphs they can make that they might end up spending a lot of time looking at relationships that don’t make that much sense or aren’t that useful rather than focusing on answering a statistical question.”

“Dragged things on to the graph without thinking about what they really wanted to look at.”
HINDERED students’ statistical reasoning

Since students don’t make the graphs by hand and it’s so easy to make graphs, they

(1) don’t choose the best graph to make
(2) make graphs that are not useful
(3) don’t understand what they mean

“The ability to drag and drop variables into the graphs also hinders the students though. With the younger students we can see them dragging and dropping variables into the graphs and then they have no idea what the meaning of the graphs are.”
Units are not obvious on the graph

“One of the issues I noticed was how the units get interpreted with the data because the units are almost always implicit which caused one of the students to interpret results that were not accurate. The students who were looking at the drop said the drop was 400 feet or 400 seconds, which are clearly very different units that have different meanings, e.g., the speed of the drop or how far the coaster dropped.”

“There was one part in the video where I thought CODAP was hindering statistical reasoning. During the video, two middle school boys were looking at their graphs and were saying that the drop was measured in seconds. If CODAP would have more clearly stated that the drop was recorded in feet, this issue would not have occurred, and the students would have been able to establish a relationship with other components.”
HINDERED students’ statistical reasoning

Not analyzing the data in the table; too focused on making inferences from the graphs rather than the table

“CODAP also almost eliminates the need to look at the actual data.”

“They don’t make inferences from numbers in table.”
Assignment: Screencast of Investigation

Record yourself using CODAP to investigate the question for a maximum of 10 minutes. The ways technology is used should illustrate best practices, and advanced skills as learned through different course tasks and resources (e.g., creating more than one graph, linking between multiple representations, using appropriate graphs and adding measures to a graph, computing measures in a table, creating new attributes based on a formula, arranging data hierarchically). The language you use during the video should be statistically accurate and you should be modelling enacting statistical habits of mind, such as considering variation, understanding measurement, connecting to the context, using multiple representations and measures to display data, and being uncertain in your claims.
Course Contexts and Participants

- 37 screencasts of roller coaster investigations from 3 institutions

- Stratified Random Sampling used to select 16 initial screencasts for analysis
  - Institution 1 (n=2),
  - Institution 2 (n=6)
  - Institution 3 (n=8)

- Video data timestamped to identify events where CODAP features were used, descriptions written summarizing events, open coding
Example: PST A [Video Link]

As you watch the video, consider:

In what ways do the features and actions in CODAP support or hinder PST’s statistical thinking? Be prepared to explain.

Investigates the relationship between **top speed** and **age group**
Example: PST B  
[Video](https://youtu.be/YIeXSM-LoQ0)

As you watch the video, consider:

**In what ways do the features and actions in CODAP support or hinder PST’s statistical thinking? Be prepared to explain.**

Investigates the relationship between *top speed*, *type* and *age group*.
Initial Findings: What actions did PSTs engage with during a roller coaster investigation?

**Actions PSTs used most often in CODAP**
- Create a graph
- Examine measures/summarize (e.g., display mean)
- Create and use graph augmentation
- Grouping data (e.g., separating a data set into two groups)

**Actions PSTs used less often in CODAP**
- Examine subsets of data
- Link multiple representations
- Calculate–make new conceptual attribute (e.g., calculate a new attribute from existing attributes)
- Merging and Joining
- Making a hierarchy
- Creating a new convenience attribute

**Summary**
Overall, PSTs used actions in ways that supported productive statistical thinking, although the extent to which this occurred varied, as well as the levels of sophistication and attention to habits of mind.

(Lee et al., 2014; Pfannkuch & Wild, 2000, 2004; Wild & Pfannkuch, 1999; Wilkerson et al., 2018)
Initial Findings: How did PSTs use CODAP features to reason about roller coasters?

**Category A**
- Limited use of CODAP features and associated actions, with minimal to no attention to context
- Unintentional/unsystematic use of CODAP features without strong connections to engaging in the investigative cycle
- Trial-and-error approach

**Category B**
- Intentional, somewhat organized/systematic use of CODAP features and associated actions, which may or may not be guided by attention to context or engagement in the investigative cycle

**Category C**
- Expanded use of CODAP features and associated actions, which are guided by attention to context
- Use of features is intentional, meaningful and strongly connected to the investigative cycle
Consider

What does this tell us about the readiness of these PSTs to teach their students to do statistical investigations with CODAP?
Discussion

- Thoughts on approach used to teach teachers to lead statistical investigations with technology?
- Thoughts on development of PSTs’ pedagogical content knowledge?
FREE! Access to ESTEEM Materials

https://hirise.fi.ncsu.edu/projects/esteem/
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