Using Videos of Students’ Statistical Reasoning to Support Preservice Teachers’ Learning of Content and Pedagogy

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Seago & Mumme (2002) hypothesized four ways in which math teachers learn from videos

- Learn *useable* mathematics
- Generalize mathematical and pedagogical ideas by looking across cases
- Develop a more complex view of teaching
- Develop new norms of professional discourse and more precise language of practice through discussion

Examples of Projects Resulting in Videos of Students/Teachers

- Integrating Mathematics and Pedagogy (IMAP)
- Children’s Mathematics / Cognitively Guided Instruction (CGI)
- Developing Mathematical Ideas (DMI)
- Learning & Teaching Geometry (LTG)
- Learning and Teaching Linear Functions
Presentation Outline

• Overview of the ESTEEM Materials

• Videos of Students’ Thinking about Categorical Association

• Videos of Students’ Investigations of Roller Coasters
Overview of the ESTEEM Materials

Hollylynne Lee
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.
ESTEEM Modular Approach

Foundation Module: Core ideas about teaching statistics and how to support students’ investigations

Association Module

Screencast Assignment

Inferential Reasoning Module

Task Design Assignment
CODAP

https://codap.concord.org

Common Online Data Analysis Platform

CODAP is supported on Firefox 46+, Chrome 50+, Windows Edge 14+, and Safari 10+. CODAP is not actively supported on other browsers at this time.
ENHANCING STATISTICS TEACHER EDUCATION WITH E-MODULES

hirise.fi.ncsu.edu/projects/esteem

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Videos of Students’ Thinking about Categorical Association

Rick Hudson
“Expertise in attending to children’s strategies is foundational to deciding how to respond on the basis of children’s understanding” (Jacobs, Lamb, Philipp, & Schapelle, 2011, p. 111).

Three Components (Jacobs et al., 2010)
- Attending to students’ thinking
- Interpreting mathematical understandings
- Deciding how to respond
Categorical Data in CCSS-M

CCSS.Math.Content.8.SP.A.4
Understanding that patterns of association can also be seen in bivariate categorical data by displaying frequencies and relative frequencies in a two-way table. Construct and interpret a two-way table summarizing data on two categorical variables collected from the same subjects. Use relative frequencies calculated for rows or columns to describe possible association between the two variables.

CCSS.Math.Content.HSS.ID.B.5
Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data.
Is there a relationship between whether a granola bar has nuts and its texture (chewy/crunchy)?

<table>
<thead>
<tr>
<th></th>
<th>NO NUTS</th>
<th>NUTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEWY</td>
<td>13</td>
<td>10</td>
</tr>
<tr>
<td>CRUNCHY</td>
<td>6</td>
<td>4</td>
</tr>
</tbody>
</table>
Transcripts

Go to https://tinyurl.com/AssocTranscript

Or view the QR code at the right.
Enhancing Statistics Teacher Education with E-Modules
Interpreting Hector

• **Attend:** Identify a statement/action Hector made that you found significant.
• **Interpret:** What does Hector’s statement tell you about his thinking?
• **Decide:** If you were Hector’s teacher, how would you respond to his statement?
Enabling Statistics Teacher Education with E-Modules
Interpreting Trina

- **Attend**: Identify a statement/action Trina made that you found significant.
- **Interpret**: What does Trina’s statement tell you about her thinking?
- **Decide**: If you were Trina’s teacher, how would you respond to her statement?
Enhancing Statistics Teacher Education with E-Modules
Interpreting Andrea

• **Attend**: Identify a statement/action Andrea made that you found significant.
• **Interpret**: What does Andrea’s statement tell you about her thinking?
• **Decide**: If you were Andrea’s teacher, how would you respond to her statement?
Enhancing Statistics Teacher Education with E-Modules
Interpreting Xavier

• **Attend:** Identify a statement/action Xavier made that you found significant.
• **Interpret:** What does Xavier’s statement tell you about his thinking?
• **Decide:** If you were Xavier’s teacher, how would you respond to his statement?
Enhancing Statistics Teacher Education with E-Modules
Interpreting Lana

• **Attend**: Identify a statement/action Lana made that you found significant.
• **Interpret**: What does Lana’s statement tell you about her thinking?
• **Decide**: If you were Lana’s teacher, how would you respond to her statement?
Reflecting on one PSTs’ Thinking

This student was not correctly reading the graph. If she would have switched the variables in her sentence to say that 30% of bars with no nuts are chewy, she would have correctly stated the conditional relative frequency. As her teacher I would want to clear up this misconception by having her understand that the column is what describes the 100% of no nut bars and the colors break up the bar into the type. I would ask her to flip the variables in her sentence and ask her what the different between that statement and the original statement is. Hopefully she would understand that the first variable in the conditional relative frequency is the variable that is 100% and the second variable is the one that breaks up the 100% into two parts.
Reflecting on another PSTs’ Thinking

She said 70 percent are chewy and have nuts but then corrected it to 70 percent are chewy and have no nuts. She has a wrong referent conception. She should have said 70 percent of the granola bars without/with nuts are chewy. 10/33 (about 30 percent) granola bars are chewy and have no nuts, but 13/19 (about 68 percent) granola bars without nuts are chewy. I would ask her what she thinks the numbers on the bar graph represent. I would ask how many total granola bars have no nuts. Then I would ask what percent of granola bars without nuts are chewy. Then how many granola bars are there total and then what percent of ALL of the granola bars are chewy AND have nuts.
What are the ways you might use videos of students thinking in your course setting?

What are the benefits or drawbacks of using the Professional Noticing framework with preservice teachers?
Videos of Students’ Investigations of Roller Coasters

Gemma Mojica
1.2.g. Investigating More Roller Coasters

https://go.ncsu.edu/rollercoasters
As you watch the video, consider the following ...

- What do you notice about students’ statistical thinking? In particular, what do you notice about students’ use of statistical habits of mind (e.g., role of context, sampling, attending to variability, measurement, being skeptical, accounting for uncertainty)?
- What does this tell you about students’ understanding?
- How does the teacher sequence students’ work to account for different student approaches to analysis and interpretations?
- Does the teacher use student ideas to make connections between statistical ideas?
1.2.i. Supporting Statistical Discourse with the Roller Coaster Task

Enhancing Statistics Teacher Education with E-Modules
Select mathematical goals and tasks.

- **Anticipating** likely student responses
- **Monitoring** students’ responses during the explore phase
- **Selecting** specific students to present mathematical ideas during the discuss and summarize phase
- **Sequencing** student responses that will be publicly displayed
- **Making connections between student responses** and key ideas

Smith & Stein (2011); Stein, Engle, Smith, & Hughes (2008)
The teacher facilitated the investigation by prompting a higher level of statistical thinking. When students were making Level A interpretations of the graphs created with one variable (i.e., this is a rollercoaster with a highest top speed), the teacher prompted them to compare one attribute with relation to another (for example top speed and the height of the drop). She then introduced the idea of bivariate associations. The instructor was encouraging students’ statistical thinking by focusing on modeling the relationships in various ways (with the aid of CODAC tool). Instead of, for example, stressing the proper name of the type of graph created. She mentions that the graph they created is called a scattered plot, but since it’s not imperative to the analysis that the students are conducting, she moves on and tells them that they will learn more about scattered plots later on.
The sequence she chose allowed the students to **see a progression of graphs that compared the same attributes, top speed and drop height.** The first group created two dot plots and generally focused on a specific case of the maximum in both categories. In the 4-expert video we watched, Dr. Lee discussed trying to get **students to move from special cases to more generalization about the group as a whole.** She did this by asking the students to extend their thought process and see if the minimum in both categories was also similar. The second group she had present also had a graph showing top speed and drop height but theirs was all on one graph which made it a bit easier to make some generalizations. The final group also created a graph with top speed and drop height but they made a scatterplot and color coded it with the types of coasters. This **allowed the students to go further in their analysis by comparing two groups** but also opened the door for higher level interpretation. The students **made claims and began to think** in the context of the problem discussing the possible danger of wooden coasters at high speeds. They **looked at the cluster of wooden roller coasters and discussed the lack of variability.** They were also truly able to **see a clear relationship between drop and speed** which the teacher help to summarize.
Discussion

• Is there evidence that the teacher supported students’ use of statistical habits of mind (e.g., role of context, sampling, attending to variability, measurement, being skeptical, accounting for uncertainty)? Provide specific examples.

• In what ways did the teacher’s interactions with pairs or the whole class build on students’ thinking and move that reasoning forward? Explain.

• How did the teacher sequence the order of students’ sharing of their work to account for different student approaches to analysis and interpretations? Explain your thinking.

• Did the teacher use student ideas to assist the class in making connections between the statistical ideas that were reflected in the shared strategies and representations? If so, how?
Questions?
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